

# Preventing deterioration of archival materials



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Unfortunately, the condition of collections tends to deteriorate due to a combination of elements such as: inadequate and careless use and handling of the documents; badly controlled environmental conditions; and inappropriate storage. Moreover, many modern materials are less durable (e. g. paper and bindings manufactured after about 1850, manuscripts, photographs). A good preservation policy must guarantee access to the information and minimize document deterioration. Thus, preservation is a core responsibility of all archival and library services possessing documents of national heritage importance.

Also preventive conservation is very important as it aims to reduce risks of deterioration: environmental control; regular maintenance and protection of the collections by using appropriate treatment, anti-theft devices and creating surrogate documents for heavily-used original documents.

Causes of deterioration may be external or internal, external causes fall into several categories:

### **Mechanical Forces**

The origin of these forces may be natural (earthquake), accidental (collapse of a roof or a shelf), or human (handling, but also vibrations from a busy road nearby).

Mechanical deterioration is most frequently caused by poor handling of documents while they are being moved, made available to readers, photocopied or photographed.

These risks are normally dealt with by the security service. Theft, like vandalism, may lead to the total loss of the object or document. Acts of war can be included in this category.

## **Fire**

Fire is a danger for all collections, but organic materials are particularly vulnerable. Fires cause widespread damage and massive losses.

## **Water**

Water is a serious threat to collections. The damage may be due to: leaking pipes, leaking roofs, flooded rivers, hurricanes, and fire-fighting. When the water damage is not discovered in time, or when rescue measures are insufficient for the scale of the disaster, then further damage is generally caused by mould.

## **Biological Agents**

Gaseous pollutants catalyze chemical deterioration of materials by oxidation and hydrolysis, ex: sulfur dioxide or nitrous oxides and ozone from motor vehicles and industry, and formaldehyde escaping from certain materials (wood, textiles, papers) used in exhibitions or for storage.

Solid pollutants cause mechanical deterioration by abrasion and encourage the spread of mould and insects, ex: soot, dust and particles.

## **Light**

Light sources, daylight as well as electric lights, all emit in variable proportions electromagnetic waves which are invisible to us. On either side of the visible spectrum there are ultraviolet and infrared radiations.

Ultraviolet radiation is of higher energy than visible radiation and causes photochemical deterioration. Infrared radiation causes deterioration by heating of matter itself or of its immediate environment particularly by affecting the level of relative humidity of the environment. Visible radiation itself carries certain dangers, as it still carries enough energy to cause changes at molecular level.

Temperature and relative humidity are linked parameters. Relative humidity is defined as the relationship between the quantity of water vapor contained by a given volume of air at a given temperature, and the maximum quantity of water vapor which this same volume can contain at the same temperature.

The levels and fluctuations of relative humidity have a much greater impact on the majority components of library and archive documents.

Because of the interdependence of temperature and relative humidity it is imperative to always control both parameters simultaneously.

Excessively high relative humidity: over 65 %) leads to the proliferation of mould and rapid corrosion of metals.

Excessively low relative humidity: leads to dehydration of organic materials which then become fragile.

Fluctuating relative humidity: they lead to mechanical stresses of varying degrees (extension, shrinking).

Excessively low temperatures: make plastic materials fragile and increases RH.

Excessively high temperatures: speed up the deterioration of unstable materials (acid paper, nitrate films, cellulose acetate films and color films).

## **Preservation of Different Archival Materials**

### **Graphic Materials Preventive Measures**

Light: its intensity and composition:

Light intensity must not exceed 50 lux , IR excluded, duration of lighting must not exceed 3 months for a display period of 8 hours a day at 50 lux. Which is applied in the showcases of the manuscripts museum.

Climate Control:

Temperature of 20° C +/- 2° C, relative humidity of 50 % +/-10 % recommended.

Combating pollution and biological agents: Protected against air pollution, not to bring organic material like foodstuffs, unauthorized cardboard packing material into storage areas, regular inspection and preventive treatment of the building (cleaning, sampling , etc.).

Handling, moving and using documents:

Documents should not be shelved too tightly or too loosely together, and force should never be used to place a document or a container on a shelf.

Metal coated shelves are preferable over wooden ones due to the acidic vapors that rise from some types of wood.

Books must be placed upright and held firmly in position, they should not be placed on the spine or on the fore-edge, and Books in boxes must be laid flat for transport.

For deteriorated manuscripts with weak spine if they were placed upright this may lead to more tearing and deterioration, so we are running a project to place our collection of about 5000 manuscripts after their cleaning and documentation of their deterioration conditions in acid-free boxes horizontally to preserve them in a better way.

The researcher must be informed of the essential rules for handling documents.

## **Microfilms Preventive Measures**

Climatic control:

The humidity level is kept above 25 % and below about 60 % and temperature at 16° C +/- 2° C.

Combating pollution and biological agents.

Handling, moving and using microfilm materials.

## **Monitoring System**

On a daily bases the temperature and relative humidity are measured and revised with the building management system (BMS) and any deviation in

the readings is dealt with instantly, in order to make sure that our collection is in the right storage and display environmental conditions.

Objects are checked for obvious fungal infection.

Settle plates are opened for one hour in the storage and display areas, and random swabs are taken.

Silica gel is used to maintain RH in the showcases of the Manuscript Exhibition Gallery which is regenerated 4 times a year.

## **Biological Agents: Inspection and Treatment**

The materials of which library and archive collections are composed, namely paper, parchment, palm leaves, birch bark, leather and adhesives used in bookbinding, are susceptible to two main forms of deterioration. One is biological deterioration caused by insect attack and/or fungal growth, and the other form of deterioration is caused by adverse environmental conditions such as extremes of dampness or wide fluctuations in relative humidity associated with large variations in day and night temperatures, light and atmospheric pollutants. These two forms of deterioration are interconnected because humid conditions favor the growth of fungi and accumulations of dust and dirt will attract insects.

Where there is condensation or moisture due to high humidity, there is always the presence of biological growths such molds or fungi, insects and rodents causing infestation. Biological agents attack paper and other organic materials when both temperature and humidity are uncontrolled. Also, man's

negligence also favors the growth and proliferation of insects. The following manifests such negligence:

- Accumulations of dirt and dust from poor or careless housekeeping practices;
- Introduction of foodstuff to storage and exhibit areas;
- Entry of insect-infested items into the collection;
- Open windows, air vents or poorly sealed windows and doors;
- Unattended roof leaks and cracks in a deteriorated building; and,
- Poor ventilation.

Rodents and insects are the worst enemies of books and other organic materials that are cellulose in nature. The materials contain proteins and carbohydrates in the form of sizing, paste or starches, and other organic substances attractive to insects. The nature and extent of the damage depend not only on the insect and material, but also on how promptly the infestation is discovered and controlled. Damage may vary from a few holes to complete destruction.

## **Insects**

The most common types of insects that attack paper objects, books components or generally archival materials in all its different forms are:

**Termites, Silverfish, Firebrat, Cockroaches, Booklice, Moths, Beetles, Weevils**

## **Stabilization**

Using a temperature fluctuating incubator: Freezing and heating kills insects safely and effectively in most cases, temperature is fluctuated between -20o



c to 48o c, this fluctuation does not give the insect a chance to adapt to the surrounding environment temperature as the temperature keeps changing and these leads to its death.

## **Microorganisms**

Microbes are ubiquitous in all environments and a library is a potential host for many different types of microorganisms that are transferred by visitors and staff to the historical objects and vice versa leading to both infection of objects and a health hazard to library, archive staff causing to them several conditions, e. g. allergic diseases, mycoses, or toxicity.

Egyptian climate creates favorable environmental conditions for the growth and proliferation of a wide range of cellulose degrading fungi and bacteria due to the relatively high humidity and temperature. So if books or manuscripts were subjected to these conditions they are most likely to be infected by microorganisms.

**When dealing with a microbial infestation the following steps are done:**

### **Microbiological Inspection**

We start by examining the archival material first visually for obvious infections, then by isolation on culture media for non-obvious infections in order to plan the method of treatment.

### **Fungi Static Procedures**

Infected books & manuscripts are put in a cool temperature incubator (except the ones with parchment binding) at -10 to -20o c for five days. This step stops the growth of mostly all living organisms on condition that they

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are stored or displayed in the right conditions afterwards for preventing microorganisms from growing back. These conditions are 18-22°C and 40-60% of temperature and relative humidity respectively.

## **Microbiological Isolation & Examination**

A sample is taken on a nutritive media to identify and quantify the bacteria and/or fungi infecting or contaminating the archive material to help decide the way of treatment and for further research studies.

After sampling, the plates are incubated for 7 days under favorable environmental conditions.

After incubation, examination is done by means of stereomicroscope and compound microscope and identification is made based on morphological traits.

## **Microbiological Treatment**

Dry pre-cleaning of the archival materials is done for safer handling & to avoid leaving stains in paper if the treatment is done without removal of fungal debris and spores.

This step is a very important as it makes the archival materials more safe for further handling by chemists and restorers to protect them from the harmful allergic effects of fungal spores caused by their touching and inhalation.

After dry pre-cleaning the disinfection or treatment method is recommended as one of two ways:

- An aqueous disinfection for non-bleeding inks by a very low concentration of a hypochlorite solution followed by de-chlorination to remove excess chlorine and to stop its effect.
- A non-aqueous disinfection for bleeding inks using diluted alcohols that are applied by spraying or by cotton swabbing.

### **Chemical Inspection And Treatment:**

Physical diagnoses of the book or manuscript is essential to determine the degree of damage and the type of treatment, usually chemical deterioration is observed then the book or the manuscript (archive) undergoes pretreatment procedures and chemical treatment.

### **Chemical Deterioration:**

Due to the hydrogen ion present in the archival materials (internal or external factors), the archive suffer from acidity which causes deterioration of many valuable rare books and manuscripts and lead to their complete loss. Thus, neutralization of the acid content of the archival material is essential. This is done by treating the archive with a base. The base varies according to the material composition.

Chemical inspection involves pretreatment procedures and chemical Treatments.

### **Spot testing**

It is a test in which a very small amount of chemicals is used to identify materials present in the artifact (paper fiber or media) only on a small microscopic sample. Identification depends on visible color change,

precipitate formation or gas evolution to identify the sample in order to predict the best possible way of treatment.

## **Chemical treatment:**

- Paper chemical treatments
- Leather chemical treatments
- Parchment chemical treatments
- Disinfection

## **Paper chemical treatments**

- Aqueous treatment
- Washing
- De-acidification
- Drying & sizing
- Non-aqueous treatment “ manuscript treatment”
- Spraying for fragile papers
- Cotton swabbing application

## **Aqueous treatment**

### **Washing**

Placing papers in a warm water bath.

### **Fragile paper de-acidification**

Direct immersing of acidic, oxidized paper in alkaline solution may cause some breakage of cellulosic fibers.

Short immersing of the same paper in a concentrated neutral salt solution , Successfully neutralizes the paper sheet where an ion exchange occurs as

acidic hydrogen ions  $H^+$  in the cellulosic fibers exchange with the cation until equilibrium is reached.

Alkaline rinse is followed to remove extra salt and to complete de-acidification leaving an alkaline reserve.

## **Disinfection**

Disinfection is applied to papers (books or manuscripts), leather and parchment in case of fungal attack. A disinfecting chemical dissolved in either alcohol or water is applied to kill the micro-organisms. The solution is prepared according to the nature of the material attacked (paper, leather or parchment) and the nature of the ink ( printed, carbonic or iron gall ink).

## **Casting**

Leaf casting is an automated restoration process which is used for printed papers by using acid-free sterilized pulp in order to fill in holes and channels made by insects in paper and mend tears and cuts.

The concept of leaf casting machines is the suction of a calculated amount of pulp dissolved in water which fill in the empty spaces.

These machines were manufactured and developed by the leaf casting team, in different sizes to be suitable for the restored material (for example a big machine is necessary to restore a huge map), except for the original one that came as a donation from Gomaa El-Maged Center. Also, the pulp used is prepared by the leaf casting team.

The chemistry and microbiology of conservation of archival materials is a new developing science which have several dimensional prospects. For one

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to work as a conservator he needs to have well knowledge of inorganic, organic and analytical chemistry, microbiological tests and identification skills, environmental sciences and conservation concepts.

So we categorize our training system into two main categories, one is for specialized students that have a scientific background and one for non specialized students. Specialized students will have the capacity to understand the mechanisms of each step of treatment and testing, while non specialized students will only understand the overall concept without the technicality that lies within every step.

Based on that we have to know the specialty of the trainees and their ability to understand the training to decide the type of training they will receive. This is done by examining their C. V. and making an inquiry to help us decide. For that we have prepared a sequence of lectures and a program of practical training for both categories.