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Threads of History: Navigating the Preservation of Aging Textiles

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ABSTRACT

Textile collections are vulnerable to a variety of deterioration factors, both natural and external. These agents, such as light (visible and ultraviolet), temperature, humidity, pollution, and pests, contribute significantly to the degradation of textiles over time. To mitigate this, preventive conservation strategies are essential, including maintaining ideal environmental conditions, controlling light exposure, and implementing an Integrated Pest Management (IPM) program. Textiles naturally age and deteriorate due to chemical processes like oxidation, the effects of manufacturing and inherent properties, which causes molecular breakdown and brittleness. Environmental factors such as temperature, humidity fluctuations, and pollution accelerate aging and promote pest activity. Light, especially UV radiation, can irreversibly damage textile dyes and fibres and pollution, both indoor and outdoorcan lead to discoloration, staining, and physical damage. Preventive measures to control light exposure and pollution, alongside careful housekeeping, pest control, and monitoring, are crucial to preserving textile collections.

Keywords: Textile conservation, Deterioration factors, Environmental monitoring

INTRODUCTION

Textile deterioration is influenced by a variety of factors, which may arise from natural processes or be induced by external forces. Preventive conservation primarily focuses on minimizing exposure to agents of deterioration. The factors that most significantly impact textile collections includelight (visible and ultraviolet), temperature, humidity, pollution and pests (Bhattacharyya *et al.*, 2016).

Understanding the optimal conditions for temperature, relative humidity, and visible light along with effective methods for filtering ultraviolet radiation and pollutantsis crucial for the preservation of textile collections. Implementing an Integrated Pest Management (IPM) program is vital for safeguarding collections against pest-related damage (Kronkright, 1990).

Natural Deterioration of Textiles:

All materials naturally undergo gradual degradation over time. In textiles, this fundamental deterioration involves the breakdown of long-chain fibre molecules into shorter segments, ultimately leading to brittleness. Additional forms of natural deterioration include:

Gradual loss of inherent moisture:

Natural fibres are derived from living organisms and possess inherent biological properties. As they age and their structural integrity declines, these fibres lose elasticity and resilience.

Effects of impurities:

Trace amounts of metals, such as copper, can significantly accelerate the deterioration of textiles when exposed to bleaching agents, ozone, ultraviolet radiation, and moisture (Merritt and Reilly, 2011).

Impact of manufacturing:

Certain manufacturing processessuch as the use of iron mordants, oils and lubricants during weaving, and bleaching treatmentscan contribute to the long-term

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deterioration of textiles.

Inherent properties:

In some cases, the methods of manufacture and the inherent properties of materials lead to forms of deterioration that are uncontrollable and often irreversible. A prominent example of such inherent vice is the use of certain metallic compounds added to silk to increase its weight and enhance drape. These compounds chemically bond with the silk fibres, eventually causing them to split and disintegrate into powder. Another instance involves the interaction between metal threads or decorative elements and textile substrates. For example, the natural degradation of wool can accelerate the corrosion of silver metallic threads, resulting in tarnishing that, in turn, stains the wool fibres (Konsa *et al.*, 2014).

Oxidation:

Exposure to oxygen naturally contributes to the degradation of fabrics, often leading to a brownish discolouration, particularly noticeable on white or naturally coloured textiles. While some oxidation by-products can be removed through water treatment, the oxidation process resumes almost immediately afterward.

Environmental Factors Impacting Textile Collection:

Temperature, relative humidity, light and pollution significantly influence the rate at which textiles deteriorate. Storing and displaying textiles in environments with excessively high or low temperatures and relative humidity levels accelerates aging, while also promoting pest activity. Consistent or drastic fluctuations in temperature and relative humidity are detrimental. As hygroscopic materials, textile fibres absorb and release moisture easily (Konsa *et al.*, 2014). Changes in humidity and temperature result in the absorption or loss of moisture, leading to dimensional shifts and mechanical stress, which can ultimately cause weak yarns to break and degrade. Both natural and artificial lighting contribute to the fading of textile dyes, with ultraviolet radiation speeding up this process and causing fibres to become brittle. Pollution, including dust and dirt, settles into the textile structure, altering its appearance and composition. Pollutants also damage dyes, finishes, and various embellishments (Gilberg, 2005).

Ideal Temperature and Relative Humidity Ranges for Textile Preservation:

Textiles should be stored at temperatures between 65°F and 75°F, with relative humidity maintained as close to 50 percent as possible. Low temperatures generally do not pose a risk to textiles and can even help slow the deterioration of textiles damaged by weighting. However, high temperatures can cause textiles to become brittle, and when combined with high relative humidity, they encourage biological activity. Conversely, low relative humidity (below 35%) can also lead to brittleness in textiles. It is crucial to avoid fluctuations in temperature and relative humidity to ensure optimal preservation (Querner, 2015).

Impact of Light on Textile Preservation:

Light exposure leads to the fading of textile dyes and can cause undyed textiles to either bleach or darken. Light acts as a catalyst in the deterioration of weighted silks. The damage caused by light is cumulative and irreversible. The extent of this damage is influenced by the type of light (ultraviolet and/or visible), its intensity, and the duration of exposure (Sanders *et al.*, 2021). Assessing the lighting conditions of collection and making necessary adjustments can help extend its lifespan. It is important to review both natural and artificial light sources in storage and display areas. Use of monitoring equipment to measure levels of ultraviolet radiation and illuminance (visible light is measured in lux) can also be done (Kumar and Shah, 2018).

Light exposure can be minimized by storing and displaying textiles in rooms without windows. While clear UV-absorbing films can reduce UV radiation, they do not decrease visible light levels. Textiles can be further protected by covering all windows with drapes or blinds, and avoid placing textiles in rooms with doors leading to the outside.

The recommended maximum illuminance for textiles is 50 lux, and all ultraviolet light should be filtered. Strategies can be considered to limit overall light exposure such as using automatic dimmer switches or turning off lights when not in use (Gutarowska and Michalski, 2012).

Types of Pollution that affect Textiles:

Outdoor pollutants, such as dust and pollen, can easily enter museums through open doors and windows, while industrial emissions and natural processes of erosion contribute to the accumulation of additional pollutants. Inside the museum, sources of pollution also arise from

cleaning products, asbestos fibres, building materials, paint, carpeting, and other interior materials. Cigarette, cigar, and pipe smoke further exacerbate indoor pollution (Mazzoli and Pessione, 2021).

Dirt and dust are significant contributors to textile deterioration. Not only do they disfigure, dull, and stain fabrics, but they also contain high levels of silica. The sharp surfaces of silica particles can cut and abrade textile fibres, especially as these fibres expand and contract in response to fluctuations in relative humidity.

Certain pollutants can directly damage textiles. Sulphur dioxide causes bleaching, discolouration, and embrittlement of fibres, while hydrogen sulphide, when combined with moisture, darkens lead pigments, tarnishes metals, and reacts negatively with finishes and embellishments. Formaldehyde, present in paints, varnishes, wood products, and carpeting, can damage some dyes, leading to fading or degradation. Finally, tar and particulates from tobacco products can stain textiles, and their removal is often difficult (Querner *et al.*, 2019).

Methods for Controlling Pollution in Storage or Display Areas

- Case-bearing and webbing clothes moths are particularly attracted to high-protein materials such as wool, silk, hair, fur, feathers, and skins. The female moth lays its eggs within the weave of the textile, and upon hatching, the larvae begin feeding on the material. As the larvae consume the fibres, they take on the colour of the materials, making them difficult to detect. The moths create tunnels through the fabric, leaving holes, or they may "graze" the surface, thinning the yarns and weakening the overall textile structure (Gutarowska *et al.*, 2017).
- Silverfish, cockroaches, termites, and woodworms feed on cellulose and damage materials such as parchment, leather, paper, fabrics, adhesives, and painted surfaces.
- Woodworms, termites, and carpet beetles are commonly found in furniture, along with the fabrics, upholstery, and internal materials that comprise the furnishings. Carpet beetles are also known to infest silk and wool textiles.
- Mold and mildew thrive in warm, humid environments. The digestive enzymes produced by these organisms cause irreversible brown staining on textiles (Smith and Thompson, 2017).

Effective Strategies for Protecting Textile Collections from Pests:

- Establish and implement a routine housekeeping plan, as pests are often attracted to dirt and unclean environments.
- Develop and enforce an Integrated Pest Management (IPM) plan, which includes regular inspections and documentation of insect sightings or insect debris. This system should involve all staff members in identifying potential problem areas or objects for systematic preventive conservation.
- Prevent the initial introduction of insects into collections by restricting the presence of flowers, plants, and potting soil in buildings housing valuable materials, as these can be common sources of infestation.
- Isolate newly acquired collection items from the rest of the collection. Inspect them for any signs of insect activity and ensure any pests are eradicated before integrating these items into storage or exhibition spaces.
- In the event of a suspected infestation, isolate the affected objects and conduct a thorough inspection of the surrounding environment to identify potential sources, such as beneath floorboards, inside upholstery, or in nests located in walls or eaves.
- If an infestation is confirmed, promptly consult with a conservator and your park or regional IPM coordinator to determine the appropriate course of action and treatment (Sular and Devrim, 2019).

Conclusion:

In conclusion, the preservation of textile collections requires an understanding of the factors that contribute to their deterioration. Environmental conditions such as light, temperature, humidity, and pollution play significant roles in accelerating the aging process of textiles, while pests and inherent material flaws can cause irreversible damage. By implementing preventive conservation measures such as maintaining ideal storage conditions, managing light exposure, controlling pollution, and establishing an Integrated Pest Management (IPM) plan, it is possible to minimize the risks of deterioration. Regular monitoring, proper housekeeping, and isolating new acquisitions can further safeguard the collection. With careful attention to these factors, the longevity and

integrity of textile collections can be significantly extended, ensuring their preservation for future generations.

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