Canadian Conservation Institute
Institut canadien de conservation

CCI Notes 13/15

Mould Growth on Textiles

Introduction

Textiles are susceptible to mould growth, which can cause staining, weakening, or complete destruction of fibres. Moulds feed by digesting the substrate on which they grow. Cellulosic fibres such as cotton, linen, and rayon are particularly vulnerable, but proteins such as wool and silk can also be affected. Mould will even grow on synthetic fibres such as nylon and polyester if they are soiled or if they have finishes that provide food for the organism.

Although mould spores are always present in the air, they are able to grow only if environmental conditions are suitable. Relative humidity (RH) between 65 and 100%, warm temperatures, and poor air circulation promote mould growth.

Mould may appear as a white or coloured velvety growth and is often accompanied by a musty odour. Isolated disfiguring spots indicate early stages of mould.

Prevention

Mould growth is unlikely to occur if the RH is below 60% and if good air circulation is maintained. To reduce the likelihood of mould growth, eliminate poor environmental conditions in storage areas, including leaky pipes and cracks in windows and exterior walls. Use portable dehumidifiers to reduce the RH, and use fans to increase air circulation (see Technical Bulletin No. 26 *Mould Prevention and Collection Recovery: Guidelines for Heritage Collections* for more information). Examine collections for signs of mould growth at least twice a year, and more often if the climate in the museum tends to be humid. Quarantine all new acquisitions until they are checked for any signs of mould before introducing them into the collection.

Health and Safety

Mould is a serious health concern. Every effort should be made to limit human exposure to it. Personal protective equipment (PPE) should be worn when handling mouldy artifacts. People with allergies or those with asthma should not be in contact with affected material or where the mould infestation is located.

The minimum level of PPE suitable for a small amount of mould (<0.3 m^2 of visible mould) is a N 95 or N 100 disposable respirator, disposable gloves, and non-vented goggles. If the amount of visible mould is more extensive, a greater level of personal protection is required (see Technical Bulletin No. 26 *Mould Prevention and Collection Recovery: Guidelines for Heritage Collections* for more information).

Some fungi produce volatile metabolites that cause unpleasant odours, including the characteristic smell associated with mouldy materials. The health effects of exposure to microbial volatile organic compounds have not been well studied. They may be responsible for some health effects. If a strong mould smell is present, a respirator with a combination of particulate and organic vapour cartridges is recommended. Some particulate disposable respirators incorporate nuisance-level organic vapour relief and may be appropriate for some circumstances.

Treatment

The information presented here is useful when a few mouldy textiles are discovered. If the mould contamination is extensive (more than a few artifacts), refer to Technical Bulletin No. 26 *Mould Prevention and Collection Recovery: Guidelines for Heritage Collections* for a comprehensive description of the health effects

associated with exposure to mould, recommended PPE, and cleaning equipment and techniques.

If mould is discovered, isolate the infested textile by sealing it in a plastic bag. This will prevent the transfer of spores to clean areas of the collection and the rest of the building. If the artifact is dry, it can remain in a container or sealed in plastic until it can be cleaned.

If the artifact is wet or damp, it should be dried as quickly as possible to prevent further mould growth. Air-dry the artifact inside a fume hood or outside, on a clear dry day, away from people and building air-intake systems. If the textile cannot be air-dried immediately, it can be placed in a freezer to prevent further mould growth. Before freezing, seal the object in a clear polyethylene bag or wrap with polyethylene film and seal with tape. Freezing is a quick method of killing actively growing mould. However, although the mould's vegetative growth will freeze and break down, the spores are able to withstand the cold temperatures and remain viable. Freezing is also a good option when there are numerous wet or mouldy objects because this method eliminates the urgency to treat or dry all wet artifacts within a short time frame. Household horizontal chest freezers operate between -18 and -28°C and can be used for a small number of objects. In general, freezing is safe for textile artifacts. If in doubt, check with a conservator.

If possible, clean mouldy textiles indoors inside a fume hood or outdoors on a clear dry day. Set up the operation away from people and the building's air-intake system. Wear the appropriate PPE.

Close vacuuming is one of the most effective ways to remove mould growth and reduce the number of mould spores on the artifact. Be systematic and thorough when removing the mould and carefully vacuum the textile all over, not just where mould growth can be seen. If possible, go over the textile twice, the second time in a perpendicular direction to the first pass. To avoid dispersing mould spores into the environment, a vacuum cleaner fitted with a high-efficiency, particulate air (HEPA) filter is strongly recommended. Vacuum cleaners with a variable speed control that can modify the vacuum suction are a good idea.

When ready to vacuum, cover the hose nozzle with fine screening to prevent loose portions of the artifact from being sucked into the machine. Do not allow the nozzle of the vacuum cleaner to touch the object because this may cause the mould to smear and stain the textile surface. Rather, hold the vacuum nozzle very close to the artifact and allow the suction to pull the mould off. A soft brush can be used to direct mould that is otherwise difficult to remove towards the nozzle. If the textile is particularly fragile, consult a conservator before attempting mechanical cleaning.

When the vacuuming has been completed, wash all work surfaces, equipment, and tools with a water and detergent solution. These items should then be disinfected with a dilute solution of household bleach and water (the bleach is diluted by a factor of 10). A contact time of 15–20 minutes is required to ensure complete disinfection.

Exercise caution when handling and discarding contaminated items (packing material, PPE, vacuum cleaner bags, etc.). Place contaminated debris in thick (6 mil) plastic garbage bags or two layers of thin plastic garbage bags. Seal and discard the bags in an outdoor garbage container.

Once all visible mould has been mechanically removed, wash or dry clean the textile, if possible. Consult a conservator before undertaking either of these procedures. Washing will help remove any remaining fungal spores and fragments. Stains and dirt can act as food for future mould growth. Washing will also help remove acidic degradation products formed by most fungi on cellulose (see CCI Notes 13/7 *Washing Non-coloured Textiles* and CCI Notes 13/13 *Commercial Dry Cleaning of Museum Textiles* for further information). Note that some mould stains may not come out and will remain as permanent disfigurements.

Considerations after Cleaning

It is not known to what extent textiles that have been only mechanically surface cleaned of visible mould growth pose a health concern. It is recommended that such textiles be identified in a manner that allows users to take precautions before touching them. This should include wearing disposable gloves when handling an artifact and washing hands with soap and water afterwards.

Storage Area

It is important that the textile not be returned to an environment that will allow mould growth to recur. Investigate and correct the cause of the mould infestation before returning the textile to the storage area. Clean and disinfect the storage area before returning any artifacts. Use cleaning methods that do not stir up dust. Damp wipe hard surfaces such as

floors, walls, and metal shelving. If using a vacuum cleaner to clean the storage area, place the vacuum cleaner outside the room and use a long vacuum hose to vacuum.

Suppliers

Note: The following information is provided only to assist the reader. Inclusion of a company in this list does not in any way imply endorsement by the Canadian Conservation Institute.

Respirators:
chemical supply houses and safety equipment suppliers

Vacuum cleaners, dehumidifiers, fans:
hardware and domestic retail stores

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