Fungi and Mold in Indoor Environments

Risk Control from Liberty Mutual Insurance

Highlights:

- Definitions of fungi and mold
- Most people do not develop allergic symptoms without extensive contamination
- 10 things to know about mold
- What to look for
- Prevention

"Fungi" refer to a diverse group of organisms that in the biological classification scheme have their own kingdom, separate from plants and animals.

Fungi do not ingest their food but absorb nutrients by decomposing dead organic matter, a trait that allows them to grow in many indoor and most outdoor environments.

Fungi produce microscopic spores to reproduce, just as plants produce seeds. These spores are commonly found in both outdoor and indoor air.

The term "fungi" is used to refer to most forms of microbial contamination commonly found in buildings. "Mold" is a term commonly used to describe visible fungal growth, just as "mildew" is a general term commonly used to refer to fungi growing on fabrics, window sills or bathroom tile.

Fungi (molds) are pervasive throughout both indoor and outdoor environments, and all people are repeatedly exposed to a wide variety and concentration of such material. Fungi produce many substances that are beneficial to mankind, while others are suspected to be potentially toxic.

In normal homes and office environments, people typically do not experience allergic symptoms without extensive contamination. Therefore, in normal situations, small isolated patches of mold do not cause symptoms, and prompt identification and remediation is the proper course of action.

Ten Facts about Mold

1. If air, moisture and organic sources are sufficiently present, molds spores can grow on virtually any substance or surface. Common examples of surfaces that are especially prone to mold growth include insulation, paper, wood, carpeting and food products. Mold can grow on metal building studs given the presence of organic dust on the surface of the metal.
2. Most individuals can be continuously exposed to mold with no apparent adverse effects. The Centers for Disease Control and Prevention noted adverse health effects associated with exposures to certain types and concentrations of mold, including allergic reactions, worsening of asthma and other respiratory complaints. These adverse health effects, however, have many other possible causes, making it difficult to establish that mold in an indoor environment has contributed to the symptoms. Typically, fungal levels are higher outside than inside buildings. There is no practical way to eliminate all mold spores from getting into the indoor environment. The way to control indoor mold growth is to control moisture.
3. If not addressed in a timely manner, excessive accumulations of water or moisture can facilitate mold growth. Entirely eliminating the presence of indoor mold spores may not be possible, but controlling moisture sources can prevent their growth. Common examples of moisture issues include:
   - Construction designs that limit natural ventilation and reduce leakage of outside air into a structure to save on energy costs may result in water vapor build up inside of the structure.
   - Leaks from the roofing, gutters, windows, or heating system and/or plumbing penetrations can allow water incursions if building envelope systems are not designed, installed, or maintained improperly.
   - Insufficient maintenance or improper design of the heating, ventilation and air conditioning (HVAC) systems can harbor and possibly distribute mold spores throughout an area or entire building.

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4. Molds can gradually consume and damage materials which can dramatically affect their appearance, and possibly their structural integrity. If left unchecked, water and/or mold damage to wood framed buildings can result in the weakening of floors, walls, or load bearing framing structure. Consult with a structural engineer or other professional with the appropriate expertise if you suspect the presence of this damage.
5. If mold is a problem in your building, you must clean up the mold and eliminate sources of moisture. Fix the source of the water intrusion or leak and dry out wet surfaces as soon as possible to prevent mold growth.
6. Reduce indoor humidity (to 30-60%) to decrease mold growth in the following ways:
   - Vent bathrooms, dryers, and other moisture-generating sources to the outside. Do not vent them to attics, garages or other indoor spaces.
   - Use air conditioners and de-humidifiers.
   - Increase ventilation.
   - Use exhaust fans whenever cooking, dishwashing and cleaning.
7. Clean and dry damp or wet building materials and furnishings, ideally within 24-48 hours, to prevent mold growth. Even if more than 48 hours have passed since water got into the building, make efforts to dry out the building because not all mold forms that quickly and removing water eliminates a key factor in mold growth.
8. Clean mold off hard surfaces with water and detergent, then dry completely. Moldy, absorbent materials, such as ceiling tiles and gypsum wall board, may need to be replaced. Depending on the size of mold growth, it may be necessary to isolate the contaminated area from the rest of the building during cleanup (reference the New York City Guidelines on Assessment and Remediation of Fungi in Indoor Environments).
9. Prevent condensation. Reduce the potential for condensation on cold surfaces (i.e., windows, piping, exterior walls, roof or floors) by adding insulation.
10. Do not install carpeting in areas where there is a perpetual moisture problem (i.e., by drinking fountains, classroom sinks or on concrete floors with leaks or frequent condensation).

What to Look For

A visual inspection is the first step in identifying a possible contamination problem. Investigators examine the physical structure including walls, floors, ceiling tiles, carpets, furnishings, material storage, spaces in ventilation ductwork, fan coil units, drain pans, air filters, supply air distribution, humidifiers, sump pumps and spaces behind walls.

Other sources of indoor air contaminants (people, pets, pests and indoor plants) can produce allergic symptoms in some people and need to be considered as possible sources as well.

Investigators look to identify potential sources of biological agents, look for evidence of current or past water damage or excess moisture, and, as needed, develop control and remediation of noted problems.

Environmental Sampling

Environmental sampling (air or bulk samples) may not be needed or called for in all investigations or to undertake remediation. There are no health-based exposure criteria or guidelines established. This prevents the simple comparison of environmental sample results to established air or bulk sampling standards or guidelines, as is done for chemical exposures.

Used properly, environmental sampling can be a useful investigative tool if the source of contamination or its exposure pathway to a building occupant is not obvious.

No specific standards, regulatory or otherwise, exist for indoor mold levels due to the lack of a sufficient correlation between exposures and consequential health effects. Due to varying levels of susceptibility to spores, sampling results sampling can have limited application. Sampling results are best used as a guide to determine the extent of mold infestation, effectiveness of remediation efforts, or as an investigative tool to identify which indoor conditions could cause elevated mold counts.

If needed, sampling for mold should be conducted by industrial hygienists or other environmental professionals with experience in sampling methods for microbial contaminants and interpretation of results. A laboratory accredited by the American Industrial Hygiene Association Environmental Microbiology Laboratory Accreditation Program (EMLAP) should be used to analyze the samples.

Common sampling methods include:

- Bulk samples of building materials.
- Air samples on impactor plates or cassette samplers to test for mold presence in the indoor air.
- Air samples on impactor plates or cassette samplers in interstitial spaces (wall cavities, electrical or plumbing penetrations, etc.) to check for hidden sources of mold.

Although air samples can provide information about a site as it existed at the time tested, the results may not represent conditions that existed in the past or predict conditions in the future. The types, concentrations and proportions of biological agents in the air vary significantly with time and that change can be rapid. Furthermore, scientifically sound quantitative sampling may be time consuming, and an investigator might consider whether mitigation rather than further sampling is warranted, given the particular circumstances.

Typically, after mold remediation has been completed, sampling (air and/or surface) is warranted to verify the cleaning was thorough. Such “clearance” testing also validates that other areas were not contaminated by the remediation work.

Prevention

Microorganisms reach indoor environments with outdoor air that enters the building, or they can be transported inside by people or along with building materials that are brought inside.

General principles for preventing microbial growth in buildings can be summarized as follows:

- Prevent mold growth on building materials, HVAC system and interior spaces by controlling moisture in the building.
- Limit the intrusion of biological particles, including fungi, from outdoor sources.
- Limit indoor accumulation of dust and biological particles from human and other sources, such as cat dander, pests, pollen, etc., by frequent and thorough cleaning.

A comprehensive strategy to resolve problems related to microbial growth in buildings includes a series of inclusive steps.

1. **Identify and Control Sources.** Investigators must understand moisture sources and water accumulation to identify potential areas for microbial growth.
2. **Remove Existing Contamination.** All items that may act as potential sources should be cleaned. Contaminated items which can be cleaned should be decontaminated. Contaminated materials that cannot be salvaged must be discarded.

a. Clean mold off hard surfaces with water and detergent, then dry completely. Moldy, absorbent materials, such as ceiling tiles and gypsum wall board, cannot be cleaned and may need to be replaced. Depending on the size of mold growth, it may be necessary to isolate the contaminated area from the rest of the building during cleanup (reference the New York City Guidelines on Assessment and Remediation of Fungi in Indoor Environments).

3. **Prevent Problem Recurrence.** Building managers must adopt operation and maintenance practices that ensure control strategies are implemented and the potential for problem recurrence is eliminated.
   a. Reduce indoor humidity (to 30-60%) to decrease mold growth in the following ways:
      – Vent bathrooms, dryers and other moisture-generating sources to the outside. Do not vent them to attics, garages or other indoor spaces.
      – Use air conditioners and de-humidifiers.
      – Increase ventilation.
      – Use exhaust fans whenever cooking, dishwashing and cleaning.
   b. Fix the source of the water problem or leak, and dry out wet surfaces as soon as possible to prevent mold growth.
4. **Prevent Pollutant Buildup.** A regularly scheduled program of cleaning, preferably using HEPA vacuum cleaners and damp dusting (housecleaning), is needed to control sources of particles and biological agents. Other methods of preventing build up include:
   a. Cleaning and drying damp or wet building materials and furnishings, ideally within 24-48 hours, to prevent mold growth. Even if more than 48 hours have passed since water got into the building, make efforts to dry out the building because not all mold forms that quickly and removing water eliminates a key factor in mold growth.
   b. Preventing condensation. Reduce the potential for condensation on cold surfaces (i.e., windows, piping, exterior walls, roof or floors) by adding insulation or pre-conditioning outside “fresh” air (in climates with high relative humidity levels) being introduced to the HVAC system.
   c. Not installing carpeting in areas where there is a perpetual moisture problem (i.e., by drinking fountains, classroom sinks or on concrete floors with leaks or frequent condensation).

References

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