



# Introduction to Preventing Indoor Workplace Mold- Related Problems

An Online Continuing Education Course for Engineers

**Course Number: BD-1010**

**Credit: 1 Hour / 1 PDH / 1 CPD**

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## Overview

### Mold

Molds are the most common forms of fungi found on the earth. Fungi are classified as neither plants nor animals, and include yeasts, mildews, puffballs, and mushrooms (2). Most molds re-produce through the formation of spores, tiny microscopic cells that float through the indoor and outdoor air on a continual basis (3).

We are all exposed to mold spores in the air we breathe on a daily basis, both indoors and outdoors. When mold spores land on a moist surface indoors, they may begin to grow and digest the surface. Left unchecked, molds can eventually destroy the surfaces they grow on (3). Molds can be any color.

Molds, their fragments, and metabolic by-products have been associated with adverse health effects. Some diseases are known to be caused by specific molds. However, in many occupational settings health conditions suspected to be mold-related cannot be linked to a specific mold as the only possible cause. In a well-known case an initial finding that *Stachybotrys chartarum* (also known as *S. atra*) was linked to acute pulmonary hemorrhage/hemosiderosis in infants living in a water-damaged environment in Cleveland, Ohio was subsequently disproved (4).

### Where Molds are Found

Molds are found almost everywhere in our environment, both outdoors and indoors. Their spores float continually in the air we breathe. Molds can grow on just about any substance, as long as moisture and oxygen are available. Mold growth may occur when excessive moisture accumulates in buildings or on building materials including carpet, ceiling tile, insulation, paper, wallboard, wood, surfaces behind wallpaper, or in heating, ventilation, and air conditioning (HVAC) systems (3, 5).

### The Causes of Molds in Buildings

It is impossible to eliminate all molds and mold spores in the indoor environment. However, moisture control is the most important strategy for reducing indoor mold growth.

Common sources of moisture in buildings include plumbing, roof, and window leaks;

flooding; condensation on cold surfaces (e.g., pipe sweating); poorly maintained drain pans; and wet foundations due to landscaping or gutters that direct water into or under the building. Water vapor from unvented or poorly vented kitchens, showers, combustion appliances, or steam pipes can also create conditions that promote mold growth (3). Mold can grow wherever there is dampness. Damp or wet building materials and furnishings should be cleaned and dried within 24 to 48 hours to prevent the growth of mold (1, 3).

### **The Dangers of Mold**

Facility owners and managers, among others, make numerous decisions about design, operation, and maintenance throughout the life cycles of their buildings.

Structural damage to buildings from mold growth is one concern for building owners and managers. If sources of moisture are not controlled, mold, which is always present to some degree, can spread and cause damage to building materials, finishes, and furnishings. Additionally, some molds can cause structural damage to wood (6).

Structural damage, however, is not the only concern. Large amounts of mold growth in buildings can create odors and may trigger health effects, such as allergic reactions, in some individuals. Illnesses that are associated with mold exposures in buildings have been listed in this course. However, the relationships between poor indoor air quality due to the presence of mold and building-related illnesses (BRIs) are unclear. This stems, in part, from the lack of standardized and meaningful methods by which to measure mold exposures and their effects on occupants. However, widespread symptoms related to a building can lead to environmental investigation, mitigation activities, relocation of occupants, and loss of tenants or property value. Problems that follow an onset of health complaints associated with buildings may impact employers located in buildings and sometimes the building owners who may have to bear high costs to resolve the underlying issues.

### **Building-related Illnesses (BRIs)**

The term building-related illness (BRI) is used to describe illnesses that are characterized by objective clinical findings related to specific exposures in the indoor environment. Building-related illnesses (BRIs) are diagnosed by evaluation of signs and symptoms by physicians or other licensed health care professionals. Mold-related BRIs result from mold contamination that has occurred in buildings under specific conditions. All BRIs are preventable by eliminating and controlling the conditions that can lead to the harmful exposures.

## **How Sick Building Syndrome (SBS) Differs from BRI**

Terms such as Sick Building Syndrome (SBS) have been used to describe situations in which building occupants experience a variety of symptoms that, unlike BRIs, appear to be linked to time spent in a building, but no specific illness or cause can be identified (8). Symptoms often disappear after occupants leave the building (9).

## **BRIs Linked to Mold Exposure**

The health effects of concern from exposure to mold contamination in an indoor environment can be common allergic BRIs such as allergic rhinitis, allergic asthma, and hypersensitivity pneumonitis (also called extrinsic allergic alveolitis) (10, 11), and infections such as histoplasmosis and cryptococcosis. Mycotoxins can also produce toxin-mediated adverse health effects. The following discussions of selected mold-related BRIs are not intended to be comprehensive, i.e., the descriptions do not include diagnostic tests or medical treatments. Rather, the discussions are informational and focused on common BRIs.

## **Building-Related Illnesses**

### **Health Effects that can be Caused by Mold**

Most people experience no health effects from exposure to the molds present in indoor or outdoor air. However, some individuals with underlying health conditions may be more sensitive to molds. For example, individuals who have other allergies or existing respiratory conditions such as asthma, sinusitis, or other lung diseases may be more easily affected. Similarly, persons who have a weakened immune system tend to be more sensitive to molds. A person's immune system can be weakened if the individual has conditions such as pregnancy, diabetes, autoimmune disease, leukemia or AIDS; or if the individual is recovering from recent surgery or receiving chemotherapy or long-term treatment with steroids; or if the individual is the recipient of a recent organ or bone marrow transplant. In addition, infants, children, and the elderly have been shown to be more susceptible to health problems attributable to molds (1, 5, 9).

The most common health effects associated with mold exposure include allergic reactions similar to common pollen or animal allergies (5). Symptoms include sneezing, runny nose, eye irritation, coughing, congestion, aggravation of asthma, and skin rash (1, 3). These symptoms are also common reactions to other agents that cause allergies, and it is not always possible to single out the specific cause. More severe health reactions, such as hypersensitivity pneumonitis, can occur in susceptible individuals.

The three types of adverse health effects in humans caused by mold are allergy, infection, and toxin-mediated conditions (12). Further discussion of these health effects is provided in Appendix A of this document.

## **Preventative Maintenance**

### **Preventing Mold Growth in Occupied Areas**

The key to mold prevention is moisture control. The most important initial step in prevention is a visual inspection. Regular checks of the building envelope and drainage systems should be made to assure that they are in working order. Identify and, to the extent possible, eliminate sources of dampness, high humidity, and moisture to prevent mold growth. Wet or damp spots and wet, non-moldy materials should be cleaned and dried as soon as possible (preferably within 24 to 48 hours of discovery).

Moisture due to condensation may be prevented by increasing the surface temperature of the material where condensation is occurring, or by reducing the moisture level in the air (humidity). To increase the material's surface temperature, insulate it from the colder area or increase air circulation of warmer air. To reduce the moisture level in the air, repair leaks, increase ventilation (if outside air is cold and dry) or dehumidify (if outside air is warm and humid). Indoor relative humidity should be maintained below 70% (25-60%, if possible) (3).

All buildings should be checked routinely for water leaks, problem seals around doors and windows, and visible mold in moist or damp parts of the building. Any conditions that could be causes of mold growth should be corrected to prevent future mold problems.

Other prevention tips include venting moisture-generating appliances, such as dryers, to the outside where possible; venting kitchens (cooking areas) and bathrooms according to local code requirements; providing adequate drainage around buildings and sloping the ground away from the building foundations; and pinpointing areas where leaks have occurred, identifying the causes, and taking preventive action to ensure that they do not reoccur (3).

### **Preventing a Mold and Bacterial Growth in the Building's Ventilation System**

Ventilation systems should be checked regularly, particularly for damp filters and overall cleanliness (1). A preventive maintenance plan should be put into place for each major component of the building's ventilation system. Components that are exposed to water (e.g., drainage pans, coils, cooling towers, and humidifiers) require scrupulous maintenance to prevent microbial growth and the entry of undesired microorganisms or chemicals into the indoor air stream (8).

## Cleaning the Building's Air Ducts

Air duct cleaning generally refers to the cleaning of various heating and cooling system components of forced air systems (13). The components of these systems may become contaminated with mold if moisture is present within the system, resulting in the potential release of mold spores throughout the building.

All components of the system should be cleaned. Water-damaged or contaminated porous components should be removed and replaced regularly to ensure a regular schedule.

Protecting building areas. The best strategy is to isolate renovation areas. Isolating the renovation area with polyethylene sheeting or polyethylene sheeting to prevent the spread of mold to other areas under renovation is essential. Air handling units that are being renovated should be locked out while they are being serviced. Positive or negative pressure in relation to adjacent areas for potential harm to workers and relocate occupants to prevent contamination from spreading to occupied areas.

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clean a component of a system. Water-damaged or contaminated porous components should be checked and replaced on a routine schedule.

remodeling areas from occupied areas. The use of either plywood or polyethylene sheeting to isolate the area under renovation is essential. Air handling units serving the area under renovation should be locked out while they are being serviced. Positive or negative pressure in relation to adjacent areas for potential harm to workers and relocate occupants to prevent contamination from spreading to occupied areas.

When undertaking renovations that break the integrity of the building envelope, such as roofing work, regular checks should be made for water intrusions at the breaks in the envelope. Water damage and standing water should be cleaned up immediately.

## Building Evaluation

### What To Do If You Suspect that Your Building Has Mold

You should look for and eliminate the source of moisture problems in the building. As stated earlier in the course, moisture problems can have many sources, including uncontrolled humidity, roof leaks, and landscaping or gutters that direct water into or under the building. Unvented combustion appliances and standing water following a flood are other sources. In addition, you should remove all visible mold. Visible mold on external surfaces, especially on the walls of a building, may be an indicator of more severe contamination beneath the surface. However, mold removal without also the correction of