

Mold in the Indoor Environment

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Introduction to Mold

In nature, molds are a part of the natural food chain. They help break down dead organic materials and can be found growing in soil, on plant matter, as well as on other organic debris. In the indoor environment, however, molds are considered contaminants. Molds produce allergens (substances that can cause allergic reactions), irritants, and in some cases potentially toxic substances (mycotoxins). In addition, in order to reproduce, molds produce tiny spores that disperse continually through the indoor and outdoor air. Due to this effective dispersal mechanism mold spores can be found almost anywhere and are generally always present in the outdoor as well as indoor air. If mold growth occurs indoors, however, airborne mold concentrations can build up increasing the likelihood of adverse health effects. For this reason mold growth in the indoor environment should be avoided.

Molds can grow on virtually any organic material as long as moisture, oxygen, and suitable temperatures are present. In the indoor environment, organic materials (wood, paper, dust, etc.), oxygen, and suitable temperatures will almost always be present. Moisture control is therefore the key to controlling mold in the indoor environment. When excessive moisture accumulates in buildings or on building materials, mold spores that land on these damp surfaces may begin to grow, especially if the moisture problem remains undiscovered or unaddressed. The purpose of this document is to help you recognize moisture problems that can lead to mold problems and to provide basic information on how to address moisture problems as well as physical mold growth.

Identifying Moisture Problems

Moisture may be present within your home in the form of physical leakage and /or seepage as well as in the form of elevated relative humidity. Common sources of moisture leakage and /or seepage include:

- Seepage through basement walls and floors
- Leaky roofs, soffits, siding, etc.
- Toilet, sink, and bathtub overflows
- Water pipe breaks or even slow drips
- Flooding

When moisture leaks or seeps into the indoor environment, it results in the saturation of structural materials as well as personal contents that may be present, providing mold with an ideal environment on which to grow. This type of problem generally results in rapid mold growth and can result in extensive damage if not addressed quickly. It is important to remove excess moisture and dry water damaged areas within 24-48 hours to prevent mold growth.



Elevated relative humidity is often an overlooked moisture problem and can be caused by several common sources including:

- Unvented bathroom, stoves and appliances (furnaces, hot water heaters, kerosene space heaters, clothes dryers, etc.)
- The use of humidifiers (particularly in the winter)
- Crawl spaces with no ground veering or poor ventilation
- A lack of general ventilation (i.e. tight houses)

When relative humidity is elevated, condensation can occur on colder surfaces. The amount of moisture that the air in your home can hold depends on the temperature of that air. As the temperature decreases, the air is able to hold less moisture. If the temperature drops below the dew point, condensation will form. Some dry tolerant mold species do not require condensation and can grow when the relative humidity exceeds 70%. It is, therefore, generally recommended that the relative humidity within your home be kept below 50%. This is most important in the winter months because of the much larger temperature differential found between interior and exterior surfaces in the winter. Common locations for condensation to form include cold spots such as window sills, in closets, behind dressers and large furniture items along exterior walls, as well as in areas where relative humidity is generally higher such as in bathrooms and kitchens.

How to Control Moisture

Indoor mold growth can and should be prevented by controlling indoor moisture. If mold growth is identified within your home the mold must be cleaned up and the moisture problem fixed as soon as possible. Delaying could cause the problem to spread. Cleaning the mold without fixing the problem may result in the mold returning. There are many ways to control moisture in your home.

- Fix leaks and seepage. If water is entering the house from the outside, your options range from simple landscaping (the ground should slope away from the house) to extensive excavation and waterproofing. Water can result from the lack of gutters or a water flow toward the house.
- Water leaks in pipes or around tubs and sinks should be addressed as soon as discovered.
- Use exhaust fans in bathrooms and kitchens to remove moisture to the outside of the house (not into the attic).
- Vent your clothes dryer to the outside of the house.
- Turn off or minimize the use of appliances such as humidifiers or kerosene heaters.
- Make use of a dehumidifier if the relative humidity exceeds 50%.
- Raise the temperature of cold surfaces where moisture condenses. Use insulation or storm windows. Open doors between rooms (especially doors to unheated closets) to increase circulation. Circulation carries heat to the cold surfaces. Move furniture and other obstacles away from exterior walls.
- Be sure that your house has a source of fresh air and can expel excessive moisture from the house.
- Pay special attention to carpet on concrete floors. Carpet can absorb moisture. Use area rugs, which can be taken up and washed often.

If moisture infiltration is caused by a flaw in the building foundation or due to construction defects, a structural engineer may need to be consulted.

How to Address Mold Growth

It is impossible to get rid of all molds and mold spores in the indoor environment. For this reason, when mold cleanup is conducted it should not be expected that a sterile environment would be achieved. The following techniques may be utilized to address mold cleanup projects and should help minimize the release of mold spores and therefore the potential for exposure to occupants and cleanup personnel. Professional cleaners or remediators may use methods that are not covered in this document.

Areas Containing Less than 10 ft² of Mold Contamination

If the moldy area is less than 10 square feet, in most cases, you may be able to handle the job yourself. Prior to cleanup, however, some precautions should be taken. The work area should not be occupied. Adjacent areas may be occupied, but it is recommended that sensitive individuals be removed. Some examples of sensitive individuals would include very young children, the elderly, people with allergies, asthmatics, or any other individual whose immune systems has been weakened.

Cleanup personnel should utilize personal protective equipment to include an N-95 respirator (available at most hardware stores), long rubber gloves that extend past the center of the forearm, and unvented goggles. Most paper dust masks qualify as N-95 respirators. Others are made primarily of plastic or rubber and have removable cartridges. In order to be effective, the respirator or mask must fit properly. Be sure to carefully follow the instructions supplied with the respirator. If the respirator is required in an occupational setting then OSHA requires a respirator protection plan to be maintained by the employer in accordance with 29 CFR 1910.134.

Mold cleanup should be conducted utilizing dust suppression methods. It is often recommended that mold cleanup should begin with HEPA (high efficiency particulate air) vacuuming of the physical mold source and surrounding areas. HEPA vacuums utilize a filter capable of trapping particulates down to 0.3 microns with an efficiency of 99.7%. Common household vacuums do not have this capability and should not be utilized in cleaning up mold since spores may pass through the collection bag and become airborne. If a vacuum with a HEPA filter is not available then the vacuuming portion of this procedure should be omitted. After vacuuming, physical mold growth can generally be removed from nonporous (hard) surfaces by wiping or scrubbing with water and detergent. Wetting of moldy surfaces will greatly reduce the amount of mold that becomes airborne, however, upon completion of the physical mold removal, adjacent areas should be damp wiped as well with water and detergent. After damp wiping, it is important to dry all surfaces quickly and thoroughly to discourage further mold growth.

Porous materials that are wet and have mold growing on them may have to be discarded. Since molds will infiltrate porous substances and grow on or fill in empty spaces of crevices, the mold can be difficult or impossible to remove completely. If you are unsure about how to clean an item or if the item is expensive or of sentimental value, you may wish to consult a specialist. Contaminated materials that can not be cleaned should be removed from the work area in sealed plastic bags. Please note that mold may cause staining and cosmetic damage. It may not be possible to clean an item so that its original appearance is restored.

HEPA vacuums are recommended for final cleanup after materials have been thoroughly dried and contaminated materials have been removed. HEPA vacuums are also recommended for the cleanup of dust that may have settled on surfaces outside of the cleanup area. Upon completion, all areas should be left dry and visibly free of contamination and debris.

Areas Containing Between 10-30 ft² of Mold Contamination

For areas containing moderate amounts of mold (10-30 ft²), specially trained maintenance personnel may still be capable of conducting the cleanup, however additional precautions should be taken. A containment should be constructed

around the contaminated area utilizing 6 mil polyethylene sheeting and the area should be maintained under negative pressure utilizing a HEPA filtered fan unit vented to the exterior of the building. Negative air should be verified with a manometer. The purpose of utilizing containment and negative air pressure during moderate sized mold cleanup projects is to provide added assurance that mold spores will not be released into the areas adjacent to the containment. The larger the area of mold that is to be cleaned, the greater the need for containment and establishing negative air pressure.

In addition to containment and negative air, the level of personal protective equipment being used should be upgraded. Disposable coveralls should be worn and respirators should be upgraded to a half-face air-purifying respirator with HEPA filtering cartridges. The cleaning techniques that should be utilized are the same as in "Areas Containing Less than 10 sq ft of Mold Contamination", however if objects are located within the contaminated area they should be cleaned and then removed from the containment prior to removing physical mold growths. Upon completion, the 6 mil poly containment walls should also be cleaned prior to removing them. If personnel are not available or properly trained to conduct the appropriate cleaning you may want to consider hiring a professional remediation and /or restoration company.

Areas Containing Greater than 30 ft² of Mold Contamination

For areas containing large amounts of mold (>30 ft²), a professional experienced in mold remediation techniques should be consulted to present options on how to conduct cleaning operations.

General Mold Remediation Practices

In some cases, cleanup may be complicated by hidden molds. It is possible that mold may be growing on hidden surfaces such as on the back side of drywall, wallpaper, or paneling, on top of ceiling tiles, under carpets and carpet pads, behind furniture, inside HVAC systems, etc. Prior to conducting a mold cleanup, if hidden mold is suspected you may want to consult a professional experienced in investigating mold and moisture problems. If hidden mold is discovered during a mold cleanup, an assessment should be conducted to evaluate whether personal protective equipment or the level of containment should be upgraded.

The use of biocides is not recommended as a routine practice during mold cleanup. In most cases, it is not possible or desirable to sterilize an area. There may be instances when professional judgment may indicate their use. In such instances biocides should be utilized in strict accordance with their product label instructions. If you choose to use biocides, always ventilate the area and exhaust the air to the outside of the building. Special gloves may also be necessary when working with certain biocides. Bleach, deodorizers, and other household cleaning agents are not regulated as biocides.

If you suspect mold is present within the HVAC system, the system should not be operated until it is inspected by a professional trained in evaluating HVAC systems.

Do not paint or caulk moldy surfaces. Clean up the mold and dry the surfaces before painting. Paint applied over moldy surfaces is likely to peel.

In specific instances, such as in cases where litigation is involved, the source of mold contamination is unclear, or health concerns are a problem, you may want to consider sampling as part of your mold cleanup project. Pre-remediation sampling can help find hidden molds and can help establish cleaning objectives. Post-remediation sampling can help determine whether remediation efforts have been successful. Sampling for mold should be conducted by professionals who have specific experience in designing mold sampling protocols, sampling methods, and interpreting results.