Questions and Answers

Mold and Moisture Control in Schools: Potential Health Effects and Safe Clean-Up Practices

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Temperature and Humidity

Q: What effect does climate have on mold growth?

A: Mold growth can be affected by climate.

Since mold requires water to grow, it is important to prevent moisture problems in buildings. Moisture problems can have many causes, including uncontrolled humidity. EPA recommends maintaining low indoor humidity, below 60% relative humidity (RH), ideally 30-50%, if possible.

Air conditioning in hot humid climates can create cold surfaces that will condense water. Also, humid weather in generally cold climates, like the Northeastern U.S, can cause condensation on un-insulated ground contact floor slabs or basement walls. These and other sources of condensation can lead to mold growth.

Q: We are having problems controlling humidity. How can we improve our humidity control? Where should we place our HVAC set points?

A: To reduce the moisture level in air (humidity), repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid).

Maintain low indoor humidity, below 60% relative humidity (RH), ideally 30-50%, if possible.

Some simple actions that will help to reduce humidity include:

1. Vent appliances that produce moisture, such as clothes dryers, stoves, and kerosene heaters to the outside where possible. (Combustion appliances such as stoves and

kerosene heaters produce water vapor and will increase the humidity unless vented to the outside.)

2. Use air conditioners and/or de-humidifiers when needed.
3. Run the bathroom fan or open the window when showering. Use exhaust fans or open windows whenever cooking, running the dishwasher or dishwashing, etc.
4. One unseen cause for elevated humidity in buildings is uncontrolled air leakage from outdoors. Air that enters through openings in the building envelope will generally not be conditioned by the air handling system.

Q: If an AC system operates around the clock because of high exterior temperatures and humidity, what would be the process resulting in cool temps [72°F] and elevated relative humidity [80%] and promoting significant mold growth on porous materials? We are experiencing this situation now.

A: This sounds like a school that I evaluated in the Carolinas. Excessive air infiltration overnight caused very high humidity without raising the temperature in the building high enough to consistently turn on the cooling. Like the answer above, if there is not a source for the humidity indoors (excessive showers, cooking, a pool, etc.) then look for air leakage. The best place to look for the leakage is where the roof joins the exterior wall.

Q: Can dirt-loaded cooling coils cause moisture to remain in air and raise relative humidity?

A: As the coils become more plugged with dirt, the air bypasses the dirty sections. Since we're trying to maintain a constant flow rate the air speeds up as it goes through a smaller area as you choke off the area of the coil. As it goes faster it will tend to carry more moisture down the duct rather than having it drop into the drain pan.

That's one of the issues caused by cooling coils. The other issue is that when dirt is impacted on a cooling coil, the cooling coil will be continually wet. That is a place that you can grow mold and typically the cooling coil is downstream of your filters so you're not going to filter it out. Then you will grow mold and distribute down the duct work. So it's a double negative to let the coils get dirty.

Remediation and Cleaning Products

Q: What is a good product to use to clean up mold?

A: A variety of mold cleanup methods are available for remediating damage to building materials and furnishings caused by moisture control problems and mold growth. The specific method or group of methods used will depend on the type of material affected.

For guidance on what method to use for your issue, check out Table 2 in EPA's Mold Remediation in Schools and Commercial Buildings document.

Q: When cleaning mold from a surface using the spray and wipe method, should you spray directly onto surface or will that cause mold spores to spread?

A: Instructions for cleaning surfaces, as listed on product labels, should always be read and followed. Whether dead or alive, mold is allergenic, and some molds may be toxic. Mold can generally be removed from nonporous (hard) surfaces by wiping or scrubbing with water, or water and detergent. It is important to dry these surfaces quickly and thoroughly to discourage further mold growth.

Q: Are mold inhibitor solutions/sprays effective if you cannot dry area completely in 24-48hrs?

A: Generally not. Some short term control may be possible, but mold will grow if surfaces remain wet.

Q: Is it best to remove the fans assemblies in a univent to clean behind them for better air quality?

A: Best? – Yes. Necessary? – Only if the uninvent has been running without filtration or there is evidence of significant dust in the fan housing.

Q: Do you recommend using biocides, like bleach, to clean up mold?

A: Biocides are substances that can destroy living organisms. The use of a chemical or biocide that kills organisms such as mold (chlorine bleach, for example) is not recommended as a routine practice during mold cleanup. There may be instances, however, when professional judgment may indicate its use (for example, when immune-compromised individuals are present). In most cases, it is not possible or desirable to sterilize an area; a background level of mold spores will remain - these spores will not grow if the moisture problem has been resolved. If you choose to use disinfectants or biocides, always ventilate the area and exhaust the air to the outdoors. Never mix chlorine bleach solution with other cleaning solutions or detergents that contain ammonia because toxic fumes could be produced.

Mold Management and Prevention

Q: Is there a reference document that discusses what materials/moisture contents are conducive to mold growth?

A: Appendix C in EPA's Building Air Quality: A Guide for Building Owners and Facility Managers includes description of necessary conditions for mold growth to occur on surfaces.

Moisture control is the key to mold control. Molds need both food and water to survive; since molds can digest most things, water is the factor that limits mold growth.

Standards or Threshold Limit Values for airborne concentrations of mold, or mold spores, have not been set. Currently, there are no EPA regulations or standards for airborne mold contaminants.

Q: Is there a sample mold management plan or a section of an IAQ management plan specific to how to set up a preventive program for mold?

A: EPA's *IAQ Tools for Schools* guidance includes a technical solution for mold and moisture.

EPA's Mold Remediation in Schools and Commercial Buildings document also presents guidelines for the remediation/cleanup of mold and moisture problems in schools and commercial buildings.

Q: What length of time is recommended for a follow-up mold inspection once mold has been remediated?

A: Prior to completing mold remediation/cleanup, use professional judgment to determine if the cleanup is sufficient. Visible mold, mold-damaged materials, and moldy odors should not be present.

You should revisit the site(s) shortly after remediation, and it should show no signs of water damage or mold growth.

Q: How do we continue to manage mold in schools after buildings have been deemed "clean" by industrial hygienists?

A: EPA's *IAQ Tools for Schools* Framework provides an effective and comprehensive indoor air quality (IAQ) management program or other overall health and safety initiatives, including guidance on mold and moisture control.

If the question is "Why" rather than "How," the answer is that mold is a growing organism that only requires water to grow again. Contrary to other physical agents like asbestos and lead, if the moisture source is not addressed then mold will grow back after remediation.

Q: What is an "acceptable content" policy?

A: Molds are part of the natural environment. It is impossible to get rid of all mold and mold spores indoors; some mold spores will be found floating through the air and in house dust. The mold spores will not grow if moisture is not present. Indoor mold growth can and should be prevented or controlled by controlling moisture indoors. If there is mold growth in your home, you must clean up the mold and fix the water problem. If you clean up the mold, but don't fix the water problem, most likely, the mold problem will come back.

Q: Can you provide examples of surface warming to prevent condensation?

A: Prevent moisture due to condensation by increasing surface temperature or reducing the moisture level in air (humidity). To increase surface temperature, insulate or increase air

circulation. To reduce the moisture level in air, repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid).

The best example of "surface warming" would be to insulate a surface (e.g., floor slab) so that the temperature of the surface will be above the dew point temperature. Another example would be to add heat to an area like a crawl space to keep all surfaces above the dew point temperature.

Evaluation and Diagnostics

Q: How often should we conduct a visual inspection and physical assessment in areas where moisture sources may be present or where remediation has been done?

A: We typically see them done twice a year in a school - sometime at the beginning and sometime towards the end of the school year. However, if there are ongoing moisture issues it may prudent to assess a little more often.

Q: What guidance can you offer to those using moisture meters as part of an evaluation? What levels of moisture activity or mold level should be considered problematic for plaster, drywall, and carpet?

A: Moisture meters may be helpful for measuring the moisture content in a variety of building materials following water damage. They can also be used to monitor the process of drying damaged materials. These direct reading devices have a thin probe which can be inserted into the material to be tested or can be pressed directly against the surface of the material. Moisture meters can be used on materials such as carpet, wallboard, wood, brick, and concrete.

Moisture meters from different manufacturers have varying procedures for evaluating "wet" versus "dry." For example, the Delmhorst BD-2100 has a scale for wood where <15% is dry and >17% is wet, while a separate scale (manually switched) for drywall indicates dry at <0.5% and wet at greater than 1%. The Protimeter MMS2 moisture meter has 8 different user-selected wood type scales for testing wood and a separate mode called "wood moisture equivalent" that reads dry if below 17% and wet if above 20%. Concrete and brick generally require a different type of meter for accurate readings. It is important to read the owner's manual for the moisture meter and understand the operation and limitations of the data.

Q: Are flat roofs more prone to moisture and mold?

A: It's important to have a way to manage water that's coming off the roof. If it's a pitched roof it should have an overhang. If it doesn't have gutters and downspouts so that it doesn't cascade down the side of the building and again charge that exterior cladding with a lot of excess moisture. If it's a flat roof then make sure your roof drains are kept clean and free flowing, and that they drain to somewhere that's not inside the building.

Q: Can you give a more specific definition for ""dampness' in a school environment?

A: It depends. If you're measuring dampness with the moisture meter it depends on the material. So “damp” when you're referring to concrete is different than “damp” when you’re referring to wood, is different than “damp” referring to dry wall.

For drywall, any source of moisture that leaves a visible stain or is visibly wet, I would consider as ‘damp.’

In general, the presence of liquid water, visible water staining, or high humidity levels (above 60% RH) would constitute “dampness.”

Q: Won’t you always find mold in an air sample? Is it more important to determine if there is a mold magnification indoors or outdoors?

A: Molds can be found almost anywhere; they can grow on virtually any organic substance, as long as moisture and oxygen are present. There are molds that can grow on wood, paper, carpet, foods, and insulation. When excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed. It is impossible to eliminate all mold and mold spores in the indoor environment. However, mold growth can be controlled indoors by controlling moisture indoors.

Q: What guidelines should be considered when determining whether mold testing/sampling should be done? When is it important for mold testing/sampling to be done before remediation?

A: Two good sources of information on bioaerosol sampling are the publications “Bioaerosols: Assessment and Control,” ACGIH 1999 and “Recognition, Evaluation, and Control of Indoor Mold,” AIHA 2008. Both of these books would recommend a visual evaluation for mold and moisture sources, followed by material sampling of surfaces prior to any consideration of air sampling for mold. If air sampling is to be done for mold, then sufficient numbers of samples need to be collected to accurately determine the airborne level (i.e., one sample is not sufficient). Data interpretation and comparison between indoor/outdoor levels and species, as well as comparing different indoor sites must be included.

Testing/sampling prior to remediation is generally done when answering insurance or legal questions.