Mold Prevention

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Mold Prevention

Indoor Humidity

Molds do not require liquid water to grow. They only require relative humidity levels from 65% to 99% at the surface on which they grow. If you keep the humidity low enough, you can prevent mold growth. Maintaining relative humidity below 50% inhibits mold and mildew growth, dust mite infestations, and bacteria. This lower relative humidity also reduces the out-gassing of volatile organic compounds (VOCs). In colder climates, wintertime humidity levels must be even lower — generally, 25% to 40% (to prevent condensation on windows).

To protect your respiratory system indoors, the relative humidity should be above 25%.

Depriving Molds of the Moisture They Need to Survive and Thrive

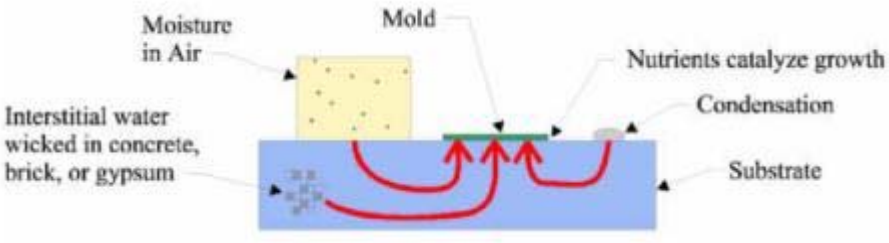
- Make sure the ground slopes down at least 6 inches within the first ten feet from each exterior wall.
- Use a properly sized air conditioner.
- Use an electrically powered dehumidifier or a natural gas desiccant dehumidifier to keep indoor relative humidity below 50 percent (as measured in the middle of rooms) and below 60 percent near the coolest surfaces.
- Remove excess humidity from the kitchen, laundry and bathroom by using an exhaust fan or opening a window.
- Use a heat recovery ventilator or energy recovery ventilator to remove excess humidity from the kitchen, laundry and bathroom while filtering the incoming fresh air to remove airborne mold spores, pollen, and dust.
- After taking a shower, wipe water droplets on the shower walls into the drain.
- Hang wet laundry outside or use a clothes dryer when indoor humidity is high.
- Reduce entry of water vapor from the soil.

1. Keep the air pressure in the lowest rooms slightly higher than the soil gas pressure to minimize entry of water vapor through pores and cracks in the concrete.
2. Use subslab depressurization to expel water vapor and radon from the soil to the

exterior so they don't leak into your home through pores and cracks in the concrete.

- Insulate any cold water pipes that have a visibly damp exterior.
- Avoid storing papers, clothing, or other "mold food", in contact with basement floors or outer walls where their moisture content could become high enough to initiate mold growth.
- Make certain that rain water drains away from the building quickly enough to prevent saturation of walls and floors that contact the earth.
- Review the additional sources of information listed below to see how others have prevented or eliminated mold problems.

Molds are incapable of obtaining the moisture needed for their development directly from the atmosphere, but they can obtain it from a substrate, which has absorbed moisture from moist air (60% to 100% relative humidity). The relative humidity of the air has an indirect effect on fungal growth, and the more hygroscopic a material was, the more susceptible it is to mold growth. The minimum moisture content at which mold growth occurs depends on the material and usually ranges from 10% to 14%. Suitable substrates include carpet fibers, gypsum, concrete, bricks, etc.



Buildings contain a mixed community of yeast, each of which may experience optimal conditions [temperature and relative humidity (Table #1) and for nutrients which extend the viable range. Even strains among species have different requirements.

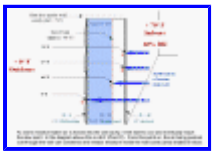
Species	Optimum			Limits				
	°F	°C	A_W	°F	°F	°C	°C	A_W
Aspergillus amstelodami	91	33	0.93	50	108	10	42	0.71
A. niger	91	33	>0.98	54	109	12	43	0.78
A. Gumigatus	104	40	>0.97	54	127	12	53	0.82
Penicillium martensii	73	23	>0.98	<41	90	<5	32	0.79
P. islandicum	88	31	>0.97	50	100	10	38	0.83
Stachybotrys atra	73	23	>0.98	45	99	7	37	0.94

Table #1: Mold Temperature and Moisture Relationships [23]
Note: A_W is the straight ratio of the vapor pressures-an A_W of 0.8 is the same as equilibrium RH of 80%.

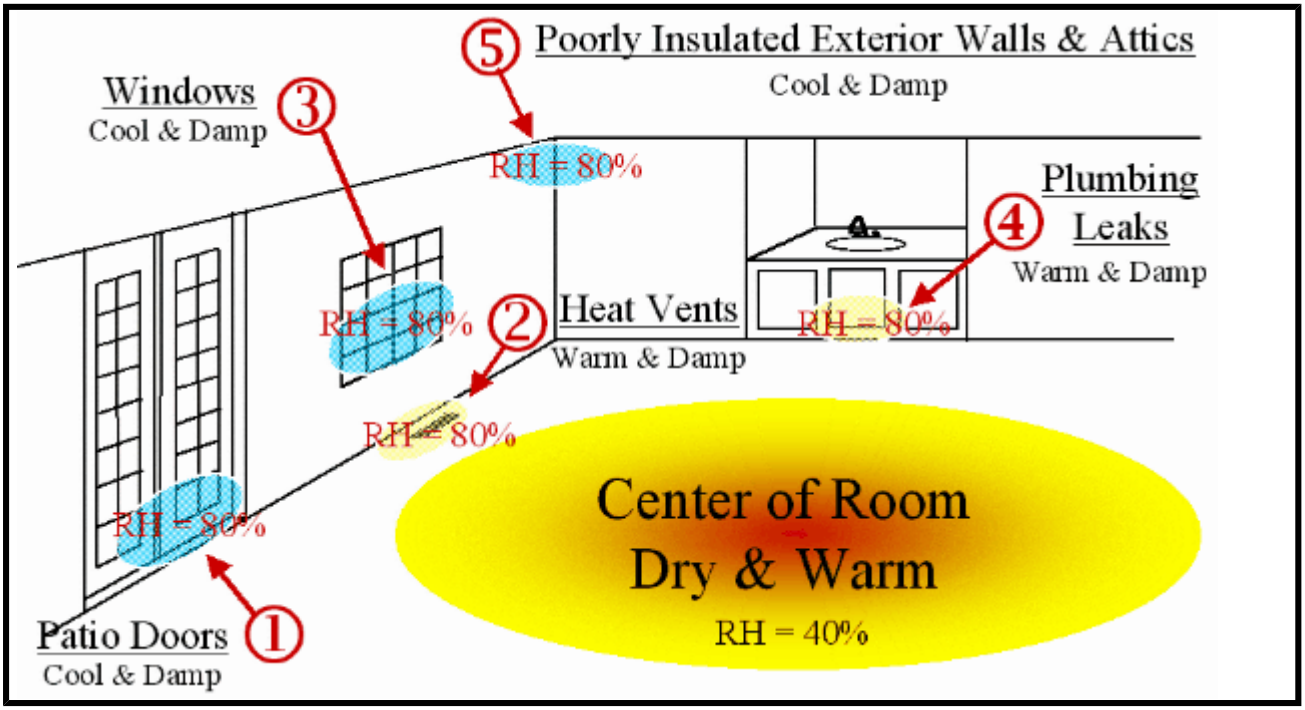
There are generally surfaces that are at a lower temperature than the bulk of a room. Consequently, although the moisture content will be the same as in air in the center of the room, the relative humidity of the air adjacent to a cooler wall will be higher. In a poorly insulated [or leaky] building, the temperature differential between the ambient air and an outer wall may be 5°C (9°F); for an ambient air temperature of 20°C (68°F) and a wall temperature of 15°C (59°F) this could mean a difference between 60% and 80%, a difference between a relative humidity that reportedly would not support mold growth and one that would. Where the temperature of a surface is at or below the dew point, water condensing on that surface will allow germination and mold growth on it, irrespective of the ambient humidity. *Where moist air permeates a porous material like concrete, brick or gypsum, condensation may be interstitial. This can then act as a reservoir of water which will permit mold*

growth to continue under ambient conditions that would have dried the surface and prevented growth.

The widespread practice of shutting down ventilation systems during unoccupied hours should be stopped. Instead buildings should continually be slightly pressurized to prevent infiltration of moist air and radon. Some dehumidifiers can help you control humidity and provide necessary ventilation at the same time.

 To enlarge the picture, click on it.

Testing Relative Humidity Levels



Crawl Spaces

Large quantities of water vapor and soil gasses can enter through the lower surfaces of crawl spaces. Here are a few suggestions:

1. Cover the entire bottom surface of the crawl space with heavy gravel or porous material at least one inch thick.
2. Cover the entire bottom surface of the crawl space with 6-mil polyethylene sheets. The sheets should be wide and long enough that at least six inches of the plastic can extend upward along each wall.
3. Seal any seams where plastic sheets overlap.
4. Seal the outside edges of the plastic to the walls.
5. Use a fan to constantly pull water vapor and soil gasses from under the plastic to the exterior.

Implement Preventative Plans to Control Mold

May 18, 2005

ATLANTA − Due to the proliferation of mold in buildings, sound moisture management should take precedence over energy cost savings, according to a new position document from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

Energy conservation goals may conflict with moisture management goals. In fact, traditional methods of dehumidification, such as reheat systems, may increase energy use, Ron Vallort, ASHRAE president, said.

“Considering energy conservation and moisture management goals in the design, construction, operation and maintenance of HVAC systems can minimize energy use and cost,” he said. “However, the impact of mold proliferation suggests that energy cost savings should not be achieved at the expense of sound moisture management.”

Minimizing Indoor Mold Through Management of Moisture in Building Systems outlines ASHRAE’s position on the management of moisture in buildings by describing issues related to the topic and highlighting resources available through the Society regarding the management of moisture and mold in buildings.

The document recommends that for proper moisture management include:

• Building envelopes, penetrations and building systems be designed and built to protect the indoor environment and the building materials from water infiltration or accumulation.

• Building and system design consider internal or exterior moisture that could cause condensation on surfaces or within materials.

• Building and system design, operation and maintenance provide for drying of surfaces and materials prone to moisture accumulation under normal operating conditions.

• Building and system design, operation and maintenance provide for water management of surfaces and materials that are expected to have moisture present.

• Mechanical system design should properly address ventilation air.

• Building and system design, construction and operation take into account occupant uses.

• An operation and maintenance plan for each building.

• The sequence of operation for the HVAC system contain appropriate provisions to manage humidity, *control air pressure* and monitor critical conditions.

• Moisture accumulation be investigated in a timely manner and steps be taken to identify and control the course of water.

The position document, *Minimizing Indoor Mold Through Management of Moisture in Building Systems,* can be downloaded for free at:
http://membership.ashrae.org/template/AssetDetail/assetid/43903

The position document is also available via the “position documents” shortcut on ASHRAE.org

ASHRAE, founded in 1894, is an international organization of 55,000 persons. Its sole objective is to advance through research, standards writing, publishing and continuing education the arts and sciences of heating, ventilation, air conditioning and refrigeration to serve the evolving needs of the public.

Contact: Jodi Dunlop
Public Relations
678-539-1140
jdunlop@ashrae.org
ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329

Additional Sources of Information:

- Moisture, Mold and Mildew (pdf format) — U.S. Environmental Protection Agency
- Moisture, Building Enclosures and Mold, Part 1 of 2 — Building Science Corporation (pdf format)
- Moisture, Building Enclosures and Mold, Part 2 of 2 — Building Science Corporation (pdf format)
- Molds & Moisture — U.S. Environmental Protection Agency
- Moisture Control Handbook: Principles and Practices for Residential and Small Commercial Buildings
- Fundamentals of Moisture in Houses
- Crawl Spaces
- Vapor Diffusion and Condensation
- Building Homes with Advanced Moisture-Control Systems
- Learn More About Mold — Building Science Corporation
- Moisture and Humidity and the Negative Implications on Your Indoor Air
- Controlling External Water Problems for Residences — Clemson University (pdf format)
- Dehumidification Basics
- Choosing an air conditioner to provide comfort and reduce humidity
- Dehumidification - Residential and Light Commercial
- Controlling Moisture on Concrete Floors — Iowa State University
- Basement Moisture — American Lung Association's Health House Project
- Basement Insulation and Mold
- Basement wall drainage alternatives employing exterior insulation
- Foundations: Moisture Resistant Construction
- Hygrothermal Performance of Basement Foundation Systems
- Controlling Basement Seepage by using Linear French Drains
- Humidity Control and Ventilation in Schools — Charlene Bayer, Ph.D. (pdf format)
- Moisture Control Strategies
- Moisture Control in Houses: The Effect of Interior Moisture on Exterior Finishes
- Managing Water Infiltration into Buildings
- Solving Persistent Moisture Problems and Moisture Damage (a case study)
- Air Properties: Temperature and Humidity
- Air Pressure and Building Envelopes
- Controlling Indoor Air Pressure
- Moisture Detection Equipment — Tramex
- Poor Building Design Leads to Fungal Growth — Aerias

- Moisture Problems in Manufactured Housing
- Measuring and Removing Moisture in Concrete
- Moisture Control Handbook: Principles and Practices for Residential and Small Commercial Buildings
- Air Tightness of Commercial and Institutional Buildings: Blowing Holes in the Myth of Tight Buildings
- Moisture and Humidity and the Negative Implications on Your Indoor Air — Aerias
- Controlling Mold Growth in External Walls
- Drainage Planes and Air Spaces in Exterior Walls
- Dehumidifiers and Humidifiers
- Using a Psychrometric Chart to Describe Air Properties
- Moisture and Humidity and the Negative Implications on Your Indoor Air
- Tyvek house wrap keeps water out and lets water vapor out
- Building Science Corporation
- Survival of the Molds

Manufacturers of Energy Recovery Ventilation (ERV) Systems

The following manufacturers make ERV systems that can help you to prevent excessive indoor humidity during warm weather and assure adequate indoor humidity during cold weather:

- AAON
- Greenheck
- Honeywell
- Mitsubishi
- NovelAire Technologies
- Therma-Stor
- Venmar

NOTE: Good drainage of rainwater away from foundation walls is important. If water in the soil near a foundation freezes, it can sometimes create enough pressure to crack foundation walls.

While tremendously strong, even the best concrete is porous. Water vapor can move through it, causing dank musty smells...rust and condensation...damage to mechanical equipment...cracked plaster...chipped paint, efflorescence, etc. Up to 80% of the moisture entering some structures is from the soil; moving into the structure both as a liquid (capillarity) and as a gas (vapor). One way to eliminate the costly problems of excessive moisture migration is to completely isolate the structure from the soil during original construction by installation of a barrier that is both water-proof and vapor-proof.

H & E Home Up

Here are some simple actions you can take to reduce energy costs, improve comfort, and reduce air pollution in your home or other building:

1. Use a powered exhaust system on any device that burns fuel indoors.
2. Eliminate the need for air leakage through your home's building envelope by using mechanical ventilation
   to supply as much fresh filtered air as you want.
3. Seal air leaks in the building's envelope to block entry of microbes, allergens, toxins, irritants, insects,
   and cold drafts.
4. Insulate the walls and attic as much, or more than, recommended for your local climate.
5. Control indoor air pressure to:

   a) Minimize entry of radon and water vapor from the soil.

   b) Keep insulation effective and mold-free by minimizing leakage of moist air through walls and attics that have been cooled by winter weather..

These actions will make your home a safer shelter if an accident, or a terrorist, releases chemical, biological or radiological substances upwind of your home.

Will additional energy price increases be ***serious, certain and soon*****?** To examine the evidence, go to:

- *Association for the Study of Peak Oil & Gas*
- *Association for the Study of Peak Oil & Gas - USA*

Wisdom *is knowing what should be done.* ***Virtue*** *is doing it.*

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Please send your suggestions, comments, and questions to Jon Traudt (jtraudt@tconl.com)