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Building-Related Moisture, Condensation, and Mold in Your Home Fact Sheet

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If you are experiencing mold growing behind furniture or on contents in a closet (see photos below), then there is too much moisture in the indoor air and/or too cold of an indoor air temperature, and this is causing moisture to condense onto the surfaces. It is this condensation of moisture onto surfaces that causes the mold to grow. No moisture, no mold.

In engineering parlance, surfaces with moisture condensation are below the dew point temperature of the indoor air. Just as when you chill a glass of water by adding ice, depending on the amount of moisture in the air (e.g. humidity), moisture will condense on the cold surface of the glass. If the humidity in the air is high, you can get condensation to occur with very little cooling of the water in the glass. The lower the humidity in the air, the lower the temperature of the surfaces required for moisture condensation.

Mold will grow on many surfaces that get wet from condensation, and can grow on surfaces without condensation, but that are near condensation conditions (e.g. the relative humidity at the surfaces that exceed 85%).

In the pictures below, the surfaces behind the couch and the back of the stereo speaker are a bit colder than the other surfaces that are open to the warm indoor air, and this attracts the moisture in the air and causes the mold growth. Same with the contents in closets that have no heat, a closed door, and an exterior wall.

To fix this mold problem, you need to fix the condensation problem. There are two solutions that can be employed; increase the indoor air temperature and/or decrease the amount of moisture in the air.

Concealed mold growth behind a couch against an exterior wall.

Concealed mold growth on the back of a stereo speaker against an exterior wall.

Mold growth on shoes in a closet.

Mold growth on a canvas duffel bag in a closet.

If the air temperature in the home is not cold (e.g. your not keeping the heater off to save on your heating bill), then the problem is not the air temperature in your home and there is simply too much moisture in the air.

You can test this with inexpensive battery operated home temperature/relative humidity sensors such as the one below.

If the relative humidity in your home is high (e.g. > 75%) then there is a risk for moisture condensation on cool surfaces. Ideally, the indoor relative humidity should not average more than 60%

If the indoor relative humidity is high, there are two solutions; increase the ventilation in the home and/or decrease the amount of moisture entering the home.

While dehumidifiers can help reduce moisture in the indoor air, they are expensive to operate, and should be considered only as a temporary band-aid solution.

If your home is new, or has recently been weatherized, it may be too "tight" to allow sufficient outdoor air into the home by natural infiltration, and you will need to keep windows open more often and/or have a mechanical system provide outdoor air to the home continuously (e.g. a heat recovery ventilator, HRV).

If your home is not under-ventilated (e.g. and older home), then the problem is probably not too little ventilation, but rather too much moisture entering the indoor air.

There are two major sources of moisture entry into homes other than outdoor air that can be a problem in hot/humid climates, and rain water leaks; occupant activities and building-related moisture sources.

Occupants and their activities such as bathing, cooking, cleaning etc. introduce water vapor into the indoor air. These can be minimized, by using windows and/or exhaust fans in the bathrooms when showering or bathing, and in the kitchen when cooking.

Correctly designed and built, buildings themselves should not be a significant source of moisture.

Crawlspaces should be dry. If a crawlspace is wet, this should be corrected. Rainwater cannot be allowed to run into the crawlspace. If there is a high water table in the area causing the ground in the crawlspace to be chronically damp then a vapor retarder can be installed over the ground. A continuous layer of 6-mil polyethylene installed over the ground and covered with a thin coat of concrete to protect the plastic from damage (sometimes referred to as rat-proofing) works well.

Concrete slabs or walls that are below grade can transmit a significant amount of water vapor into a home if there is inadequate water-proofing between the concrete and the ground. Often there will be telltale signs of moisture transport through the concrete that appear as visible white deposits on the concrete surface (i.e. efflorescing salts) or warping and cupping of wood floors installed over concrete slabs. In this case, the concrete needs to be water proofed, ideally at the exterior before the moisture enters the concrete. For below grade exterior concrete walls a French drain is a solution. This involves trenching down the exterior of the concrete wall, water proofing the exterior of the concrete and back filling with gravel and a PVC collection drain pipe. For concrete slabs, the only solution is to waterproof the interior concrete surface with a sealer.

The following is a do-it-yourself diagnostic test for determining whether the building itself is a source of moisture entering the indoor air.

DIY Building-Related Moisture Diagnostic Test.

To determine if high indoor water vapor concentrations are related to non-occupant activities such as a moisture transport from a damp/wet crawlspace, or moisture transport through a slab-on-grade foundation or basement floor and walls, the following test is a simple and useful diagnostic test.

Using inexpensive T/RH sensors such as the one pictured above, place one or more in the indoor air of the residence when the home will be unoccupied for a couple of days (thus eliminating moisture related to occupants and their activities). If there are significant water features (e.g. aquariums, fountains) in the home, then best to remove these for the test, ditto if there are lots of watered plants. Windows need to be closed and no operation of dehumidifiers or cooling equipment. The heating system can be set to operate at the normal temperature set point. Before leaving the residence, open all windows and air the home out for 30 minutes to remove any residual occupant related moisture, then close all of the windows.

Upon return to the residence, record the T and RH from the sensors, then place the sensors in the outdoor air at a location that is not in direct sunlight and wait 10 minutes for the sensors to equilibrate and then record the outdoor air T and RH.

Take these data and input the T and RH into an online dew point temperature calculator, such as http://www.decatur.de/javascript/dew, and record the calculated dew point temperatures.

If the dew point temperature is significantly higher indoors than outdoors (e.g. more than 2 degrees F higher) then there is a source of non-occupant related moisture that is building related and entering the residence, such as moisture transport from a damp/wet crawlspace, or moisture transport through a slab-on-grade foundation or basement floor and walls. The larger the difference between the indoor and outdoor air dew point temperatures, the larger the source of moisture entering the residence. At this point further investigation is required to determine the source and design a correction.

If the dew point temperature is NOT significantly higher indoors than outdoors (e.g. less than 2 degrees F higher) then there is not a significant building-related source of moisture. In this case, the moisture condensation and subsequent mold growth on surfaces is the result of too much moisture in the indoor air and/or too cold of an indoor air temperature. In this case, the solution is to reduce the moisture in the indoor air by utilizing windows and exhaust fans in bathrooms and kitchens to remove occupant activity related moisture, and keeping the indoor air temperatures from becoming too cool (a situation that often occurs in residences in cooler climates where the occupants cannot afford to operate the heating equipment sufficiently to keep the indoor air from being too cool).