



# INSULATION FACT SHEET: MOISTURE

Source: Department of Energy

## MOISTURE IN YOUR HOME

There is always some moisture in the air around us. An indoor relative humidity of about 50% is usually considered a healthy level because it is comfortable for humans and because many molds and mites are unlikely to thrive in that environment.

### *When Is Moisture a Problem?*

Even though you need some moisture in the air you breathe, too much moisture in your home can cause problems. When moist air touches a cold surface, some of the moisture may leave the air and become liquid, or condense. If this happens on a cold pane of window glass, you will see the water run down and collect on the window sill, where it may ruin the paint or rot the wood trim. The water may even freeze, producing frost on the inside surface of the window. If moisture condenses inside a wall, or in your attic, you will not be able to see the water, but it can cause a number of problems. For example, mold and mildew grow in moist areas, causing allergic reactions and damaging buildings. Structural wood may rot and drywall can swell. If moisture gets into your insulation, the insulation will not work as well as it should, and your heating and cooling bills will increase.

### *How Does Moisture Come into Your Home, and How Does it Move Around Inside the Building?*

The most obvious way that moisture enters your home is through rain, either falling on a leaky roof, wind-driven against a poorly-sealed wall, or collecting against (and eventually leaking through) the walls of your basement or crawl space. Roof leaks are usually noticeable and must be repaired immediately. Rain coming through a wall may be less apparent, especially if it is a relatively small leak and the water remains inside the wall cavity. These kinds of leaks may occur around window or door frames, so it is important to replace any missing or cracked caulking. Rain seeping through the ground into your basement or crawl space may appear as damp, moldy walls or

may be handled by a sump pump. In any event, you want to be sure that all rain coming from the roof, gutters, or across the landscape is directed well away from your house.

You also *generate moisture* when you cook, shower, water your indoor plants, use unvented space heaters, do laundry, even when you breathe. More than 99% of the water used to water plants enters the air. If you use an unvented natural gas, propane, or kerosene space heater, all the products of combustion, including water vapor, are exhausted directly into your living space. This water vapor can add up to 5 to 15 gallons of water per day to the air inside your home. If your clothes dryer is not vented to the outside, or if the outdoor vent is closed off or clogged, all that moisture will enter your living space. Just by breathing and perspiring, a typical family adds about 3 gallons of water per day to their indoor air.

Because air always contains some moisture, *any air movement carries moisture with it*. Did you know that your house breathes? We inhale and exhale through our noses, but your house inhales through one air pathway and exhales through another. Usually houses inhale around their bottom half and exhale around their top half. These air pathways include all available openings, both small and large. Back when homes had central fireplaces or open furnaces, the chimneys took care of most of the exhaling. Now, however, much of that job is handled by small leaks through your walls, floors, or ceilings. Remember that if any air is leaking through electrical outlets or around plumbing connections into your wall cavities, moisture is carried along the same path. The same holds true for air moving through any leaks between your home and the attic, crawl space, or garage. Even very small leaks in duct work can carry large amounts of moisture, because the airflow in your ducts is much greater than other airflows in your home. This is especially a problem if your ducts travel through a crawl space or attic, so be sure to seal these ducts properly (and to keep them sealed!). Return ducts are even more likely to be leaky, because they often involve joints between drywall and

ductwork that maybe poorly sealed, or even not sealed at all.

Moisture also moves through a process called *diffusion*. Diffusion occurs if some part of your home has a higher moisture level than another part, such as the movement of moisture from the bathroom to the bedroom after a hot shower has filled the bathroom with steam. Another example of diffusion is the movement of moisture through a floor above a damp crawl space and into the house above. Diffusion happens even if there is no air movement at all. Just as heat travels from a hot space to a cold space, even if it has to go through a wall, water vapor will travel from a space with a high moisture concentration to a space with a lower moisture concentration, again, even if it has to go through a wall. Cold air almost always contains less water than hot air, so diffusion usually carries moisture from a warm place to a cold place.

*Liquid movement* can also happen within your walls, such as when water runs down an internal wall surface, or seeps through your insulation. Capillarity is another kind of liquid movement, and it can carry moisture from the ground up into your walls. This is the same process used by trees to carry water from their roots to their leaves. (Did you ever put a stalk of celery into a glass of colored water and watch the color climb to the leaves?) This process can carry water through concrete slab floors into your home. It can also carry water from the foundation into your walls, so your builder should include a vapor retarder between the foundation and the walls.

Moisture can also enter your home during the *construction process*. The building materials can get wet during construction due to rain, dew, or by lying on the damp ground. Concrete walls and foundations release water steadily as they continue to cure during the first year after a home is built. During the house's first winter, this construction moisture may be released into the building at a rate of more than two gallons per day, and during the second winter at a slower rate of about one gallon per day.

We have talked about moisture moving through your house, but your house is also able to *store moisture*. All building materials, including the wood studs within your walls and the gypsum wallboard, can hold a certain amount of moisture and still do their job properly. So if your weather alternates wet times with dry times, the building materials may be able to hold the moisture until drier air carries it away. But if the drying times are not long enough, or often enough, the extra moisture will cause problems.

### ***What Does Insulation Have to Do with Moisture Problems?***

Adding insulation can either cause or cure a moisture problem. When you insulate a wall, you change the temperature inside the wall. That can mean that a surface inside the wall, such as the sheathing underneath your siding, will be much colder in the winter than it was before you insulated. This cold surface could become a place where water vapor traveling through the wall condenses and leads to trouble. The same thing can happen within your attic or under your house. On the other hand, the new temperature profile could prevent condensation and help keep your walls or attic drier than they would have been.

So how do you know what to do? Your home's moisture performance will depend on the type and position of the insulation, whether you install a vapor retarder, and where the vapor retarder is located. We used to think that the best insulation approach only depended on your weather. But now we know that it is more complicated than that. Moisture problems and their solutions depend not only on your climate, but on the type of house construction, the amount of moisture you produce inside the house, the way you ventilate your house, and the temperature conditions you maintain inside the house.

### ***So How Can You Avoid Moisture Problems?***

Here are things you should consider:

- You need to stop all rain-water paths into your home by making sure your roof is in good condition and by caulking around all your windows and doors.
- You need to place thick plastic sheets on the ground of your crawlspace to keep any moisture in the ground from getting into the crawlspace air, and then into your house.
- You need to ventilate rooms that have moisture generated by human activities within your home, such as bathing, cooking, etc.
- It is very important to seal up all air-leakage paths between your living spaces and other parts of your building structure.