Homeowner's Guide to **Moisture and Humidity**

Many homes suffer from condensation and mould growth. If serious moisture problems are ignored, permanent damage can occur to a home's windows, interior finishes, and structure. Prolonged exposure to some moulds may also cause health problems.

What Causes Moisture Problems?

Condensation occurs when humid air is cooled below its "dew point." Mould growth usually occurs on any surface that remains wet or damp for a prolonged period of time. The two factors that determine whether condensation will or won't occur are the "relative humidity" of the air and the temperature of the various cold surfaces (particularly windows) in the home.

What is Relative Humidity?

Relative humidity tells us how "wet" or "dry" the air is, and refers to the amount of water vapour the air can hold. This depends on air temperature; for example air at room temperature can hold over 10 times more water vapour than air at -5o Celsius. As air is warmed, it expands and its relative humidity decreases, because warmer air can hold more moisture. On the other hand, as air is cooled, it shrinks and its relative humidity increases. Condensation occurs when relative humidity reaches 100 percent.

To Reduce the Relative Humidity of the Air in Your Home, You Can:

1. Increase air temperature by turning up the heat, although this will increase your heating costs, or

2. Reduce the amount of moisture in the air by:

- Eliminating moisture sources (storing firewood outside, etc.)
- Diluting it with air that is drier (ventilating the house with outside air during the heating season)
- Removing moisture from the air (dehumidification)
- Deal with excess moisture at source areas such as bathrooms and kitchens with exhaust fans

Why Does Surface Temperature Matter?

Cool surfaces reduce the temperature of nearby air. If air is cooled enough that its humidity reaches 100 percent, condensation occurs and problems begin. Condensation typically starts on windows because they are the coldest surfaces in most homes. If indoor humidity continues to rise, condensation and mould growth may also occur on other cooler surfaces, such as outside corners, behind furniture, or in closets with outside walls.

Do I Need More Ventilation In My House?

It depends on your home and your habits. Every building can tolerate some moisture before problems begin to occur, and each household's cooking, bathing, and living habits are different. If window condensation and/or mould growth occur frequently, it is time to take action.

How About Opening Windows?

Windows are just as likely to allow outside air into the house as let inside air out—and incoming air can push the moist air into the rest of the home. On calm days, air may not move at all. Worse still, hardly anyone will leave windows open on cold days, when you may need ventilation the most. On the other hand, exhaust fans, such as range hoods and bathroom fans, positively remove air from the building.

What Should I Do First?

Start by checking your home for ways to reduce moisture levels at the source. It is always better to control moisture at its source than to remove moisture after the fact. After all, it costs money to install and operate a fan. Here are six suggestions for reducing an older home's moisture levels.

1 Cover any exposed earth in crawl spaces or basements with heavy polyethylene to stop evaporation into the house. This is most important.

2 Dry and store firewood under cover outdoors.

3. Fix basement leaks. Make sure gutter downspouts direct water away from the foundation, and ensure that the ground adjacent to the house slopes away from your foundation.
4. Vent clothes dryers outdoors, avoid drying clothes indoors.
5. Operate existing exhaust fans more often.
6. An excessive number of indoor plants also contributes to high moisture levels in your home.

What Is the Next Step?

If moisture problems continue, thoroughly examine your house to determine where and when problems are occurring. Common problems are discussed below. Possible solutions are listed from least to most expensive.

1. Problems are not widespread and occur only in (or near) "wet" areas such as bathrooms or kitchens.

Likely Cause: Moisture generated by cooking or showering isn't removed fast enough.

Possible Solutions:

- Reduce moisture generation when possible - use lids on pots or take shorter showers.
- Improve existing ventilation - increase air flow by operating your existing fan(s) longer, cleaning the fan, upgrading ducting, or replacing the fan with a more powerful unit.
- Add more ventilation - install quality bathroom, kitchen, or central exhaust fans as appropriate.

2. Problems are concentrated in the coldest room(s) in the house such as an unused bedroom.

Likely Cause: Room is too cold. Lower temperatures increase relative humidity and reduce exterior wall and window surface temperatures. Both make condensation more likely.

Possible Solutions:

Add heat by:

- Turning up the heat, although this will increase your heating costs
- Opening air dampers and registers
- Removing any blockages over heaters
- Opening or undercutting doors to increase circulation
- Increasing heat distribution system capacity to affected areas

3. Mould formation is limited to a few defined areas.

Likely Cause: Missing insulation or large air leaks have cooled surfaces enough to cause condensation.

Possible Solution: A Home Energy Assessment or infrared imaging can help you identify problem such as inadequate insulation and air leaks.

4. Your basement is damp or musty during warmer weather.

Likely Cause: The ground cools below-grade concrete walls and floors enough that they become the coldest surfaces in the building in the summer.

Possible Solutions:

- Insulate walls and floors to raise concrete temperatures (exterior insulation) or to keep humid indoor air from reaching the cold concrete (interior insulation and an air barrier). This is the best solution when possible.
- Close windows and doors to avoid bringing in more moisture laden air, then use a dehumidifier to control basement humidity levels. This is often the most practical solution in an older home.

5. Window condensation occurs on only a few windows.

Likely Cause: Problem windows are cooler than the rest of the windows in the house.

Possible Solutions:

- Leave tight-fitting drapes open during cold weather to keep windows warmer.
- Weather-strip and air-seal windows and frames.
- Add a permanent or temporary storm window.
- Ensure that problem window isn't isolated from a source of heat.
- Replace window with an energy-efficient window.

6. Widespread window condensation occurs throughout home and there is some mould growth on drywall.

Likely Cause: Overall humidity levels are too high.

Possible Solution: Install additional ventilation. Choose quality equipment that is quiet and capable of continuous operation.

So What Are My Options?

Range Hoods

Range hoods vented to the exterior are an effective way to exhaust odours and moisture from cooking, particularly if grease or fat is present. The capacity, quality, and noise levels of range hoods vary greatly. Some range hoods can have exhaust capacities as high as 1,200 CFM (cubic feet per minute) and may be powerful enough to pull flue gases from the furnace or wood stove into the home. For this reason, you may want to limit the use of powerful range hood fans at the same time that heating equipment (oil, wood or gas) is operating or install a less powerful fan. A draft test (using a "blower door") on your home will indicate whether your exhaust fans make your house susceptible to combustion spillage from heating equipment.

Bathroom Fans

Good quality bathroom fans can solve minor bathroom moisture problems if they are properly sized and installed. Look for a fan with a rated capacity of at least 100 CFM, a minimum 10 cm (4 inch) outlet, and a "squirrel cage" type blower. The cost of this type of fan starts at about $70.

Don't buy a fan with a sone rating (a measure of sound levels) above four. More expensive fan units tend to be quieter (a sone rating of two or less) and better constructed. The National Building Code requires that all fans in a new house must have a sone rating of two or less. Low-cost, low-capacity (50 to 60 cfm) bathroom fans aren't a bargain at any price. They are noisy, don't exhaust air effectively, and won't stand up to frequent use.

Installing a bathroom fan

To exhaust enough air to keep moisture from damaging your bathroom, you need a quality bathroom fan and proper installation. Here are a few tips:

Where should I put the fan?
Most bathroom fans are mounted in the ceiling and vented out a gable end wall. In retrofit applications, or when the attic isn't accessible, it may be easier to install the fan in the top of a storage cabinet or adjoining closet and run the exhaust duct out the wall below ceiling level. This also keeps the exhaust duct short and warm.

Where should the exhaust hood be?
Exhaust hoods work best when located on a wall. Terminating a duct into the roof overhang is not recommended, since incoming attic ventilation air may carry the moist bathroom air back into the attic, and the back-draft damper won't work when hanging upside down. Roof-mounted vents add an unnecessary hole to your roof, and if duct condensation occurs, it can drip into the bathroom through the fan.

What about ductwork?
Ducts should be at least 10 cm (4 inch) in diameter (or no smaller than the fan's outlet, if it is greater than 10 cm) and be as short, smooth, and straight as possible. Ducts in cold spaces should be sloped to the outside and must be sealed and insulated to prevent condensation and moisture damage to the attic. Flexible plastic dryer hose should not be used, because the duct's rough surface will restrict the fan's air flow.

Who installs bathroom fans?
Most ventilation contractors and some carpenters or electricians install bathroom fans, but no trade specializes. Be sure to discuss the points raised in this fact sheet with prospective contractors before deciding who to hire.

Control suggestion
Automated Timers (available for about $20 - $30) are an ideal control for bathroom fans, because wet towels, shower enclosures, etc., continue to produce moisture after you leave the bathroom. You should set the timer for 20 - 30 minutes to help ensure that much of the moisture is exhausted outside.

Central Exhaust Fans

These systems are ideal for many older houses that aren't particularly air-tight but still need some extra ventilation. Most central exhaust systems have enough capacity to exhaust from several areas of the house, replacing several smaller exhaust units, helping to justify their higher cost ($300–$350 plus installation). Quality central exhaust systems are quiet and suitable for continuous operation.

In line fan mounted in the attic

Installing a central exhaust fan
Adding a central system to an older house is usually not difficult, as long as either the attic is accessible or the basement isn't finished. In an attic installation, choose a fan approved for use in cold temperatures and use insulated flexible ducts to prevent condensation. Often, nearly all work can be done in the attic or through closets without disturbing the living areas of your home.

What's the best way to control a central exhaust system?
Automated timers are a good choice in bathrooms or other areas with short-term ventilation requirements. If the system is also expected to control indoor humidity levels, consider a humidistat located in a central area or a 24-hour timer to automatically turn on the fan at scheduled intervals.

How does the fresh air get in?
Older houses are often drafty enough that the air exhausted by a moderate-size fan can be easily replaced. But air leaks in your home may not be located exactly where you want more fresh air, so exhaust-only systems can cause cold air drafts. Air quality throughout the home may also vary. If more fresh air is needed in a particular area, intentional holes to the outside (small ducts) can be added to bring in fresh air. These ducts must be carefully located to avoid drafts.

Should I Buy a Heat Recovery Ventilator?

A Heat Recovery Ventilator (HRV) is a complete whole house ventilation system that brings air from outdoors into the home and exhausts air from inside the home to the outdoors.

A typical HRV unit is comprised of two fans—one that pushes household air out of the home and the other which brings fresh outside air into the home. What is unique about an HRV is the heat-exchange core. The core transfers heat from the outgoing stale air to the incoming fresh air. HRVs are ideal for air-tight, moisture-prone homes because they replace the humid air with drier, outdoor air. HRVs can recover up to 85 percent of the heat in the outgoing airstream, making these ventilators a lot easier on your budget than opening a windows. HRVs contain filters that keep particulates such as pollen or dust from entering the house.

HRVs are designed for, and work best, in new homes that are air tight. In this type of home, virtually all fresh air is introduced by the HRV. In an older, leakier home, air continues to enter the home through cracks and holes, so the heat recovery and fresh air distribution advantages of an HRV are mostly lost. It can also be expensive and difficult to properly install an air distribution duct system in a finished house. A less elaborate and less expensive central exhaust system can provide enough extra ventilation to control humidity in many older houses.

Does My Existing Exhaust Fan Work?

To check air flow at your exhaust hood, turn on the fan and hold a thin piece of paper, such as toilet paper, over the grill. A working fan will hold it tightly against the grill. Poor quality fans or fans with undersized ductwork may work so poorly that they can not hold up even a single piece of toilet paper.

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