

Moisture Control in the Indoor Environment:

A Practitioner's Viewpoint

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The topic of humidity control is a timely subject in northern climates as colder weather sets in, buildings are closed up for the winter and the outdoor air becomes increasingly colder and drier. Frequently the subject evokes lots of emotion and lots of misinformation and thus is a controversial subject. This isn't surprising given that most information available to the public has the vested interest of the newest and best gadget device or method. Even the medical community frequently lacks depth and accuracy in the information they provide. With all this confusion and interest in the topic here is a heating ventilating and air conditioning (HVAC) practitioner's point of view. In addition to an HVAC practitioner these viewpoints are those of an indoor air quality (IAQ) practitioner as well.

The ultimate question is why we consider humidifying indoor environments. Is it comfort, health or preserving precious furniture and artwork? Well the answer is yes to all these criteria. Our human bodies are incredible machines. The soft mucous tissues of the upper respiratory system are very effective humidifiers themselves. Our lungs like saturated air as they need to remain moist for effective function and to preserve the body's precious hydration. As we exhale each breath this soft tissue absorbs much of the moisture of the exhaled breath and uses it to add humidity to the next inhaled breath. When the inhaled breath is very dry the tissue becomes less effective and the body infuses it with moisture from the cells to preserve humidification to the lungs. Ever wonder why your nose "runs" in the winter? The body isn't great at precisely regulating this moisture infusion and it frequently provides excessive moisture. When the upper respiratory system becomes dried out it is a very uncomfortable feeling that all of us have experienced at one time or another.

The other factor affecting human comfort is the impact on perceived thermal comfort. Our skin like most of our body is mostly water. When the air becomes excessively dry moisture evaporates from the surface of our skin creating a sensation of chilling caused by the effect of evaporating moisture. Our skin is cooled by this effect. Dry air can also cause discomfort from dry cracking skin, hair and scaling, most of which have varying degrees of unpleasantness.

Excessively dry air can also be detrimental to health. Apart from complications from dry mucous membranes and tissue, dehydration and skin issues, overly dry upper respiratory tissue can become "microcracked". This means the incoming inhaled breath has a pathway to the circulatory system. In most healthy humans this isn't a big problem but depending upon what the tissue is exposed to and the relative immune resistance of the person, it can increase the risk of infection of viruses and bacteria. This in part can explain why the common cold is more prevalent in winter months than other times of the year. Be advised there is no universal consensus about this in the medical community thus should be understood for its anecdotal value only.

Okay so given all these reasons to provide positive humidity indoors in the colder winter (drier) months why shouldn't every space be humidified? Well there are risks associated with humidification as well.

Molds, fungi and certain bacteria thrive in damp (wet) environments. There are basically three things necessary for excessive growth of these things (microbial amplification). They are spores, nutrients and regular wetting just like the other plants in their phylum. Spores are rarely a limiting factor as they are ubiquitous with hundreds and even thousands of spores in every cubic foot of typical indoor and outdoor air. Buildings with a previous history of microbial amplification are likely to have a much higher spore count. Since spores are extremely small they are rarely filtered out of the airstream with other than the most efficient filters found in cleanrooms, hospitals and special clean environments (HEPA). So basically spores are everywhere. The next factor is nutrition. Plants like sources of carbon, all and every type of carbon. Our buildings like our bodies are constructed with lots of carbonaceous materials. These molds and fungi are so adaptable and efficient they can thrive on the walls of dust-free galvanized steel ductwork using the trace oil films from manufacturing as a nutrient source. Sounds crazy but it's not uncommon.

The most limiting factor to amplification is regular wetting. This term "regular wetting" is used to describe the liquid state of water not water vapor although they are closely related. Indoor spaces with humidity will form moisture droplets any time they fall below their "dewpoint". The term dewpoint is a complicated metric that is a function of humidity, temperature and atmospheric pressure. For this description we can think of it as the surface temperature that creates condensation. Condensation equates to liquid water thus creating the most limiting factor to growth. In cold climates there are many surfaces indoors to cause condensation at some combination of temperature and humidity.

Improperly applied, installed and/or maintained humidifiers can cause condensation which typically results in amplification of stuff that generally isn't healthy to humans and damages buildings. Over the past five years or so there is more agreement in the professional community that molds and fungi need liquid water and not just high levels of humidity. It's quite common to see amplification when there is wetting. At some particular combination of indoor humidity level and surface temperatures there will be condensation. Most buildings have less than ideal thermal envelopes. Even good windows have a relatively low thermal resistance (R-value) and will be much cooler than other surfaces. Accordingly that's why the windows are typically one of the first places to form condensation. Unfortunately there are many other interior surfaces that aren't so visible like the inside of ductwork, foundation walls and uninsulated water pipes. So the degree to which humidity is added to air inside the thermal envelope must be regulated to keep all surfaces above the dewpoint or it will likely result on stuff growing. This "stuff" is usually more harmful than the benefit received from adding the humidity.

There is one more significant risk associated with humidifiers themselves. Older, less expensive recirculating evaporative humidifiers have some type of sump that is used to wet the evaporating pad or media. This sump is typically unsanitary and becomes a haven for all sorts of growing stuff. Imagine this scenario, the humidifier breeds and amplifies the "stuff" then the apparatus blows it throughout the

indoor space. Sounds crazy but it is quite common. Steam is always the safest type of humidification since it is inherently sterilized and absorbs readily into the airstream. Unfortunately it's also the most expensive apparatus to install and operate. The non-recirculating evaporative and ultrasonic humidifiers are also good choices.

One other challenge should be considered when it comes to humidity control; exhaust. Most indoor environments have strong sources of humidity from clothes driers, bathrooms, and kitchens. In commercial environments there are a myriad of other sources as well. Although the humidity can be desirable, proper control is crucial. No one would argue that an occasional shower without the fan on or a pan of boiling water is problematic but excessive moisture causing regular wetting will likely lead to problems. Insure that venting systems adequately export the humidity outside the complete building structure and not dumped in an unheated attic where it's likely to create even more damage. Many bathroom fans are sold on price, make noise but hardly move air. If the exhaust grill won't firmly hold a couple of squares of toilet tissue against the fan isn't working adequately.

Unfortunately it's quite difficult to get quality product, objective information, installation and maintenance in the marketplace. For something as common as humidification, surprisingly there is more misinformation than accurate and objective guidance. This is quite common in the IAQ field leading to many purchases of "silver bullet" junk equipment and appliances. One of the best sources of good product information in the annual report on humidifiers on Consumer Reports. The best source is your local professional installer and service contractor. Take the time to check their credentials and experience, however.

So these risks beg the question can an indoor space be safely humidified. The answer is a qualified "yes". If good apparatus is installed, operated and maintained the benefits can outweigh the risks but remain objective if those risks are too high. Each space is different and must be individually evaluated