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Indoor Air Moisture — A Bad Rap?

We're not built to notice low relative humidity before it starts doing damage, which is why your building should.

Humans spend a great deal of their time in buildings constructed to protect us from harsh outdoor conditions. Paradoxically, the very nature of this containment can promote the accumulation of harmful indoor pollutants. A prime culprit for poor IAQ is excess moisture, and consequently, buildings have become drier and drier.

It is well known that excess moisture within a structure can result in conditions that promote harmful microorganism growth, building material degradation, and illness in the occupants. Every HVAC engineer, building contractor, and architectural designer is educated in the management of water in all of its phases. Vapor barriers, air exhaust fans and intakes, perimeter drainage conditions, building insulation, cold-water pipe insulation, avoidance of thermal channels, and more are some of the strategies designed to keep the building envelope and interior spaces dry.

Surprisingly, it is less well known that the opposite condition, excessively dry indoor air, can be as uncomfortable and debilitating for people as overly damp buildings. It is well documented that indoor air RH between 40% to 60% is optimal for people, yet maintaining indoor air RH is rarely mentioned in building guidelines or codes — except perhaps in nursery greenhouses. Even in hospital operating rooms where patients may have large surface areas of inner body tissues exposed, indoor air RH may be as low as 20%. This non-physiologic moisture level can lead to major problems for the vulnerable patient.

Why, then, is overly dry air not addressed as an indoor air contaminant? Perhaps the oversight is because consequences of excess moisture such as mold growth can be seen and smelled, while dryness is invisible, falling into the category of "out of sight, out of mind." In addition, studies have shown that we (humans) cannot directly perceive low indoor RH and only complain of the air being "too dry" when physiological damage has already occurred — not when we encounter the injurious condition. Conversely, we can easily feel the consequences of high indoor air RH when temperature and humidity rise to the point of decreased convective and evaporative cooling of our skin and mucous membranes by inhaled air.

Despite building occupants' delayed awareness of dry indoor air, the many health benefits of properly circulated and humidified indoor air makes this a critical parameter to maintain. The challenge of controlling moisture accumulation in the building envelope and indoor materials must be simultaneously addressed if our buildings are to be truly "healthy."

How do the illnesses from overly dry indoor air compare to those from excess moisture and fungal growth in a building structure? What is the timing of exposure to these conditions and the consequent symptoms in people?

Occupant Illness	Too Dry (RH < 40%)		Too Wet (RH < 60%)	
	Symptoms	Time	Symptoms	Time
Allergic			Sneezing, conjunctivitis, runny nose	Immediate to delayed
Irritants and toxicity	Dry eyes, excess drainage, dry skin with cracks	Immediate, prolonged	Runny eyes	Immediate relief
Infection	Increased viral infections, cough	Delayed, prolonged	Sinusitis, pneumonia	Delayed, prolonged

TABLE 1. Table showing effects of indoor air moisture conditions on building occupants' symptoms.

RESULTING CLINICAL ILLNESSES

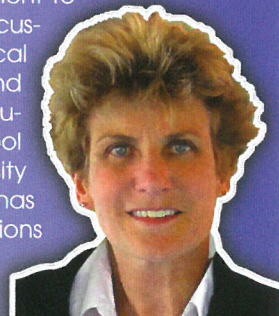
In contrast to vague comfort studies, results derived from clinical studies under controlled conditions show that dry air leeches moisture from eyes, skin, and respiratory tract mucosa. This can result in the following diseases.

Eye irritation occurs with breakdown of the aqueous phase of the tear film. The aqueous film provides essential humidification of the ocular surface, sliding of the eyelids, and clears pollutants. Consequently, tear film disorders can result in severe impairment of vision and eye injury.

Significant water loss from the skin with prolonged indoor RH below 30% causes an increase in dry, brittle, and cracked skin, and exacerbation of chronic atopic dermatitis and psoriasis.

Low RH can dry out and inflame the mucous membrane lining of the respiratory tract, increasing the risk of colds, the flu, and other infections. Some micro-organisms also survive longer, and spread more easily when humidity levels are low. **ES**

Dr. Taylor is CEO of Taylor Healthcare Commissioning, Inc. Her lifelong commitment to promoting health includes focusing on improving the physical environments of hospitals and universities. Dr. Taylor is a graduate of Harvard Medical School (MD), and Norwich University (Masters Architecture). She has numerous research publications in *Nature*, *Science*, and other peer-reviewed journals.



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