

Ventilation, Humidity Control and Energy:  
A Tightrope of Challenges and Opportunities  
by  
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Greetings:

Good morning and welcome to America and our nation's capital city Washington D.C.

I bring you greetings from Richard Rooley, the current ASHRAE President who lives in England and was not able to be in attendance for this great meeting. I also bring greetings from the more than 55,000 members of ASHRAE in the 128 countries around the world. I know that many of you are ASHRAE members since I've worked with several of you in various other parts of the world.

This is a very timely and exciting conference that's addressing issues that are at the very core of the building and controlled environment industry. Never before have we been at a time when these subjects have been more important.

We are however walking a tightrope. How do we provide sufficient ventilation for IAQ yet maintain an appropriate moisture balance without using excessive energy?

Keeping our balance on the tightrope depends on the qualifiers in this question. I.e. "sufficient", "appropriate", "excessive". -- Sufficient ventilation? Appropriate moisture balance? Excessive energy?

And it also very much depends upon the "provide", "maintain" and "without using" verbs and adverbs.

We have many good papers over the next couple of days that are addressing these critical issues. I want to spend just a few minutes this morning discussing some of the issues that we need to consider in order for us to keep our delicate balance on this difficult tightrope. – And in particular issues related to moisture and mold since they are playing such a key role in this equation.

While problems related to humidity and mold have gained much recent public attention in the last few years, the need to control humidity stems back to the beginnings of modern HVAC.

Willis Carrier, that pioneer in modern environmental control and the father of air-conditioning, had the following definition of air conditioning: "Air conditioning is the control of the humidity of the air by either increasing or decreasing its moisture content. Added to the control of humidity is the control of the temperature by either heating or cooling the air, the purification of the air by washing or filtering the air, and the control of air motion and ventilation."

Note that Dr. Carrier identified air conditioning as the control of humidity – not temperature. We have oftentimes lost sight of this definition as we have tried to walk that tightrope of providing ventilation and minimizing energy. This has resulted in us losing our balance and mold has oftentimes been the result.

Mold and ventilation and heating systems has become a large and important problem, especially in the humid areas of the southern United States. However mold problems have been identified in every state in the US and in most countries around the world.

#### **Current status:**

Mold may have been around for approximately 400 million years but its entry into the litigation scene is recent. According to the Guy Carpenter reinsurance intermediary firm, there were at least 10,000 "toxic" mold cases filed in the US and Canada in 2001, of which around half were filed against insurance companies for bad faith<sup>1</sup>.

In only two years, claims have skyrocketed. The typical homeowners mold claim now costs \$15,000 to \$30,000 to handle, compared with \$3,000 to \$4,000 for the average homeowners claim not involving mold. US insurers paid out \$1.3 billion in 2001 and at least \$3 billion in mold related claims in 2002.<sup>2</sup>

The first media reports on the mold issue in 2000 and 2001 were characterized to a large degree by excitement bordering on hysteria. Since then the media frenzy has peaked and there has been a marked shift in the content of the media coverage. By the end of 2003, press reports usually included recognition of the uncertain scientific basis for many claims of permanent injury from household mold and urged people not to panic.<sup>3</sup>

Nevertheless, a report published in the Environmental Claims Journal last summer described mold as a litigation "perfect storm" and attributed its escalation to a number of factors including: a few high-profile plaintiffs, the ingenuity of the plaintiffs bar, intense media coverage and uncertain science.<sup>4</sup> The American Bar Association has indicated that mold, mildew and humidity-related problems will be a bigger market for trial lawyers than asbestos and tobacco.

The rise in mold claims has had a significant impact on homeowners' insurance premiums - if they have been able to get insurance. The average cost of coverage is expected to rise by 7% in 2003 and 9% in 2004. Several insurers have announced new restrictions on the sale of homeowners insurance due to the mold problem. For example in Texas the number of insurers writing homeowners coverage fell from 276 in 1990 to 162 in 1997 and down to 128 in 2001.<sup>5</sup>

While homeowners mold crisis may well have peaked in 2002, the migration of the problem to areas of commercial insurance has the potential to affect many more lines of businesses. There is a great deal of increased liability in the commercial arena and there have been several highly publicized cases. For instance in April of 2003, the Hilton Hotels Corporation filed a \$95 million case over construction defects in its Kalia Tower in Honolulu. The hotel opened in May 2001 but was forced to close the week after the ASHRAE meeting was held there in 2002.

So we realize there is a problem. Mold is having a severe impact upon us; and excessive ventilation and reducing the energy to control the humidity are oftentimes being blamed. Thinking as most good problem solvers you ask: -- "So what can we do to maintain our balance?"

### **Tightrope of Challenges and Opportunities:**

Within the last year there have been three major activities that I'd like to describe in more detail to give us some insight on some of the challenges and opportunities we should keep in mind as discuss the papers to be presented over the next couple of days.

#### NIST/HUD Healthy Homes Initiative Workshop – Mold in Housing<sup>6</sup>

In late October 2002, NIST and HUD invited several individuals representing six categories of stakeholder groups to participate in a workshop to assess the problems in mold in housing and propose solutions. The stakeholder groups identified were:

- Owners and occupants: direct investors, building managers, homeowner and tenant associations
- Finance and underwriting: lenders, insurers, real estate agencies, etc.
- Producers: product manufacturers, builders, system contractors, etc.
- Delivery system "gatekeepers": building code officials, inspectors, etc.
- Remediators: contractors and service providers
- Research and regulatory agencies: public and private sector organizations.

There were several common trends in the summary report recommendations from the breakout sessions of the stakeholder groups. Highlights of the consensus action items include:

- The focus should be on moisture control and mold prevention.
- Education and training needs to be expanded:
  - Designers and architects

- Builders and installers: proper storage and use of building materials
- Owner/occupants: homeowner's manual, maintenance history, prevention guidelines, failure detection
- Remediators: technical, construction and evaluation knowledge
- The public awareness needs to be increased:
  - Need credible, recognized authority
  - Better dissemination of peer-reviewed research
  - Consensus messages, shared information
  - Counter misinformation from mass media
- Better data is needed
  - Measurement of IAQ, detection of mold
  - Benchmarks, goal posts
  - Health effects and outcomes, critical exposure
  - Susceptibility of construction materials
  - Predictors of building failure
  - Costs of failure (including medical) and remediation
- Incentives for good practices need to be identified for
  - Builders
  - Owners and occupants
  - Lenders
  - Insurers

### Mold in the HVAC&R Industry Seminar

At the June 2003 ASHRAE Annual meeting there was a seminar on "Mold in the HVAC&R Industry"<sup>7</sup>. The leaders of six major industry associations gave position statements regarding issues related to mold. The groups represented were: Air Conditioning Contractors of America (ACCA), Air-Conditioning and Refrigeration Institute (ARI), Mechanical Contractors Association of America (MCAA), National Environmental Balancing Bureau (NEBB), Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), and ASHRAE.

While it's difficult to include all the perspectives of the organizations represented, there was agreement that the following were key issues:

- **Educating consumers** —
  - Proper sizing, selection, installation, and maintenance (proper sizing in particular);
  - Proper maintenance and cleaning, not just the system but the entire building;
  - Recognizing the signs of mold; and
  - What to do when mold is encountered.
- **Getting federal government involved** - Encouraging and sponsoring research to identify molds and concentrations, and developing minimum acceptable levels of mold concentrations.

- **Getting cognizant, technically-qualified groups involved** - Establishing methods to control mold, and develop minimum standards and benchmarks for moisture and mold. As one group indicated, “Mold issues should not be resolved by people with “J.D.” or “Esq.” after their names.”
- **Raising the performance of remediators** - Identifying what is expected of them, creating standards for their performance and education, and certifying mold identifiers and remediators.
- **Upgrading construction practices** - Correctly applying technologies (envelopes, vapor barriers, sizing/selection), acknowledging the impact of ventilation, as well as the need for proper, ongoing maintenance and cleaning.
- **Promoting sound contractor practices** - Properly sizing, selecting, installing, and maintaining equipment, and determining and controlling humidity levels, including during the unoccupied mode.
- **Training on building operation** - Improper operations can lead to high humidity and mold if unattended. Poor controls function and poor system operation are prime reasons for high humidity and mold growth. Old buildings need recommissioning or retrocommissioning.
- **Providing affordable property and medical insurance** - Covering building occupants and HVAC technicians, and providing liability coverage “for well-trained professionals.”

It was announced during the seminar that the Mechanical Contractors Association of America (MCAA) will be introducing its “Microbiological Management Plan” this fall. This plan was described as offering offensive and defensive tools to address the opportunities and liabilities inherent microbiological management. This includes a basic understanding of microbiology, health concerns related to mold, habitats for mold growth, and relevant study guidelines and standards in use today. The plan emphasizes the need for a microbiological plan manager – someone responsible for keeping up to date with current standards, updating the plan regularly, overseeing the education of employees, developing a work practice doctrine, and educating customers.

#### ASHRAE Presidential Ad Hoc Committee on Mold

The third major activity I’d like to highlight is the report of an ASHRAE Presidential Ad Hoc Committee which was charged to identify some of the HVAC and building science policy issues related to mold. Included in their report were five major challenges and opportunities which the building science community must address:

- 1) **Any public policy that affects either building envelopes or HVAC systems has the potential to either contribute to the avoidance of mold problems or to create more of them.**

A few highly publicized mold cases have gotten the attention of lawmakers. The potential legislation resulting from this attention could either help or hinder solving the problem. Oftentimes policy makers don’t have the time needed to understand the delicate balance of the tightrope of ventilation, humidity and energy and as a result they

make laws or regulations that are counterproductive to solving the problem. We must always remember that the laws of nature and thermodynamics take precedence over the laws of man.

To take advantage of the opportunity to improve buildings and to limit these problems, building science resources should be consulted *in significant technical depth* before laws and policies are developed. These technical resources need to be credible and come from recognized authorities. The building science community must share information and have a consensus message with better dissemination of peer-reviewed research.

The very definition of a “mold problem” is a prime example of the lack of a consensus or even a consistent message. The Ad Hoc committee spent a great deal of time attempting to come up with a definition. Due to the lack of minimum benchmarks for unhealthy mold concentrations, the committee finally decided to separate the health definition from the engineering definition. They settled on an engineering definition of a *mold problem* as “fungal growth of sufficient magnitude to damage the appearance or to reduce the useful life of the building, its components or furnishings.”

## **2) Adherence to the principles and practices described in the technical literature should reduce the risk of indoor mold problems.**

We know how to keep the problem from occurring – we just need expanded education, training and execution of proper principles and practices.

Mold growth requires an organic food source which contains an excess of moisture. Many, if not most, indoor mold problems are associated with inadequate exterior flashing, plumbing leaks, water spills, floods and similar difficulties – i.e. moisture control problems. Other building mold problems are associated with excess indoor humidity, the hygrothermal performance of building envelopes and microbial growth in HVAC systems. We need to recognize the difference in these two types of problems and address them individually

The focus on mold prevention should be on moisture control. Expanded education and training is needed: for designers and architects on preventing moisture intrusion into buildings; for builders and installers on proper storage and use of building materials; for owners and occupants on prevention guidelines, and failure detection; and remediators on technical, construction and evaluation knowledge.

Standards and guidelines are often used to provide the impetus to uniform application of proper principles and practices. The ANSI/ASHRAE Standard 62, *Ventilation for Acceptable Indoor Air Quality*, is the most widely recognized guideline to provide for ventilation requirements for acceptable indoor quality in commercial buildings. This Standard is based on scientific and engineering expertise, but it has also become a focal point for debate involving political, regulatory, health and economic interests. This debate lengthened the time it took ASHRAE to revise Standard 62. Yet the fact that ASHRAE opens its standards to public review is why standards like this are suitable for

adoption in building codes and why they are widely used on a voluntary basis by practitioners.

A companion ventilation standard for residences, ASHRAE Standard 62.2, was adopted just this last June. This standard requires whole-house mechanical ventilation.

ASHRAE has also formed a Technical Committee on Moisture Management in Buildings following concerns from members, chapters and others in the industry that the issue of humidity control in hot humid climates had not been properly addressed in ASHRAE literature. Of particular concern was a perceived conflict between the energy requirements of Standard 90.1 and the indoor air quality requirements of Standard 62. Problems related to moisture have prompted concerns relative to the levels of ventilation required in Standard 62 and the ability of single component, high-efficiency HVAC systems required in Standard 90.1 to adequately dehumidify the air being supplied to commercial, institutional and industrial buildings.

**3) Preventing mold problems in buildings and in HVAC systems is a *shared* responsibility among all parties involved in the design, specification, construction, commissioning, maintenance and use of buildings.**

Mold problems often seem to occur where the responsibilities of these groups overlap, or where there are gaps in which no specific profession is conscious of a responsibility. In light of current concerns, each group in the building industry should review its current practices and standards to ensure these are comprehensive enough to prevent mold problems.

**4) Avoid moisture accumulation and if it does - get it out quickly.**

Mold growth in buildings should be avoided through the use of design, construction and maintenance practices that limit the accumulation of moisture indoors – either intrusion of liquid moisture or from condensation of water vapor. Equally important is to provide for the swift elimination of moisture. Even under normal conditions, small amounts of moisture may collect periodically in building assemblies and HVAC systems. In organic materials, any such moisture accumulation must be removed quickly to avoid mold problems.

**5) Defining the health effects of mold is the expertise of the toxicologists and health professionals - it is not the building scientists' expertise.**

What we *know* is that mold impacts some groups more than others. What we *don't know* however is the "acceptable levels".

The building industry needs to continue to be informed by the evolving understanding of human health effects of building-related mold as defined by peer-reviewed results published by health professionals.

While some have indicated that completely defining the “acceptable levels” is something that might take years to accomplish, there is progress being made.

At the beginning of 2002 one of the US National Academies of Science, the Institute of Medicine, started a project “Damp Indoor Spaces and Health”<sup>8</sup>. This is a comprehensive review of the scientific literature regarding the relationship between damp or moldy indoor environments and the manifestation of adverse health effects, particularly respiratory and allergic symptoms. The review will focus on the non-infectious health effects of fungi, including allergens, mycotoxins and other biologically active products.

In addition, it is expected that the report will also make recommendations or suggest guidelines for public health interventions and for future basic science, clinical, and public health research in these areas. A final report is expected shortly and we anxiously await the finding of this report.

## Conclusion

In conclusion, I’d like to quote from President Rooley’s inaugural address when he was describing the qualities of great buildings – “It is in creative brilliance, diversity and confrontation that great buildings are created. It is for harmony, sensitivity and in use that great buildings are judged.” As we spend over 90% of our time indoors, it is imperative for each of us that we must design, build and maintain great buildings. Surely, as we try to balance the issues of providing sufficient ventilation for IAQ yet maintaining an appropriate moisture balance without using excessive energy we have our work cut out for us.

The US National Academy of Engineering recognized air conditioning as one of the top ten engineering achievements of the 20<sup>th</sup> century<sup>9</sup>. In just over 100 years of life, the leaders of our industry changed our way of life and enabled millions to survive and be productive in hostile environments. I’m confident that we will be able to continue to use our similar engineering skills to solve this problem as well.

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<sup>1</sup> Harry Zimmer III. Nov 2001. "Reinsurance Perspective" in "Toxic Mold: A Growing Risk?" a Guy Carpenter Seminar Report. [www.guycarp.com](http://www.guycarp.com)

<sup>2</sup> Robert P. Hartwig and Claire Wilkinson. Aug 2003. "Mold and Insurance", Insurance Issues Series Vol 1(4). Insurance Information Institute, New York, NY ([www.iii.org](http://www.iii.org))

<sup>3</sup> Robert P. Hartwig and Claire Wilkinson. Aug 2003. "Mold and Insurance", Insurance Issues Series Vol 1(4). Insurance Information Institute, New York, NY ([www.iii.org](http://www.iii.org))

<sup>4</sup> Randy J. Maniloff, "Mold: The Hysteria Among Us", Environmental Claims Journal, Vol 14(3), Summer 2002

<sup>5</sup> A. M. Best; Texas Coalition for Affordable Insurance Solutions

<sup>6</sup> NIST/HUD Healthy Homes Initiative Workshop: Mold in Housing – Characterization, Prevention, and Remediation Workshop Summary. October 2002.

<sup>7</sup> Mold in the HVAC&R Industry. Seminar at the 2003 ASHRAE Annual Meeting. Kansas City, MO. June, 2003.

<sup>8</sup> National Academy of Sciences, “Damp Indoor Spaces and Health”  
<http://www4.nationalacademies.org/cp.nsf>

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<sup>9</sup> National Academy of Engineering, Greatest engineering achievements of the 20th century.  
[www.greatachievements.org](http://www.greatachievements.org)