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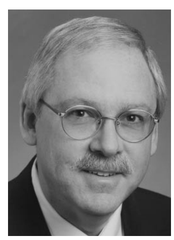
M/E Roundtable

INDOOR AIR QUALITY

Pro IAQ, Anti-Mold

BY BARBARA HORWITZ-BENNETT, *Contributing Editor*

Scheir



Odom

Liette

Kemp

Baker

Participants

Robert Scheir, Ph.D.
President
Steril-Aire
Burbank, Calif.

Terrance R. Liette
Director and Principal
Fanning/Howey
Celina, Ohio

Wayne A. Baker, CIH, RPIH
Director
Air Quality Services
Michaels Engineering
LaCrosse, Wis.

Nick Kemp
New Product
Development Manager
Dristeem
Eden Prairie, Minn.

J. David Odom
Principal
Liberty Building
Diagnostics Group
Orlando, Fla.

Air-conditioning coils, rainwater intrusion and even cleaning methods are cited as sources of mold. Proper design that avoids oversizing systems and emphasizes peer review in planning is the solution.

CSE: What are the leading causes of mold and poor IAQ in commercial and institutional facilities?

SCHEIR: In my opinion, the air-conditioning coil is the source of most IAQ problems, even though water intrusion is most often cited as the culprit. But water intrusion has existed for thousands of years, yet today's widespread mold and IAQ problems did not become prevalent until the '70s and early '80s, a time frame that closely parallels the growth of the installed base of air-conditioning systems.

AC coils provide a cool, moist garden for the propagation of mold and other microorganisms. These organisms multiply to huge concentrations, creating a hidden buildup of mold throughout the coil.

KEMP: Exactly. Then, as the fan operates, it spreads the mold along with the associated mycotoxins and spores into the airstream, and this is intensified if the mold spores find other damp spots to continue growing.

LIETTE: That's true, but there are other causes. Cleaning methods, for example, especially for materials such as carpeting or ceiling tile, can also result in moisture that remains after cleaning and is simply expected to dry. Unfortunately, circumstances may result in an environment that is inadequate for drying—and hence, good for the mold growth. Inadequately controlled HVAC systems tend to sub-cool freshly cleaned spaces, resulting in moisture-laden air rather than a drying of air as is expected with air conditioning. There are times when such sub-cooling is simply a function of a space not being occupied to the maximum designed capacity—such as in many institutional facilities that are thoroughly cleaned during the summer months, a time when the load of students and lights doesn't impact the cooling system.

BAKER: The underlying causes of mold can always be traced back to missed opportunities in the design, construction, operation or maintenance of buildings. And not only is it im-proper maintenance, but many public schools suffer from years of deferred maintenance.

In other types of buildings, mechanical systems were oversized during the design process. But even a perfect design will be rendered ineffective if the ductwork leaks excessively, or if the filters and coils aren't kept clean.

And you can't rule out water. Water migration via foundations is also extremely common, and can be related to deficiencies in siting, grading and provisions for moving precipitation away from the building; drain tile, choice of materials for backfill, routing and insulating rainwater leaders, and adequate extensions must all be considered.

ODOM: Absolutely. In our experience a leading cause of mold is rainwater intrusion resulting from inadequate architectural design that poorly details the building's envelope. This is often compounded by the poor installation of systems. Rarely does anyone provide adequate quality control and documentation of critical rainwater management elements such as flashing, caulking and window installation.

To the notion of mechanical problems, HVAC-related humidity problems in hot, humid climates are frequently a function of poor design. Virtually all HVAC-related moisture and mold problems occur within the first summer season after a building is occupied.

CSE: How can designers, in the planning and design stages, address potential IAQ and mold issues that might plague a building?

LIETTE: First of all, engineers must be careful not to oversize cooling systems, which results in the kind of sub-cooling I've already mentioned. System components can be designed to include opportunities for reheat and load reduction to help better assure the capacity needed is as close to the actual load as possible. Self-contained systems or unit ventilator/fan coil systems should not be the system of choice, because they have limited flexibility to adjust to differing load conditions.

It's also important to always meet or exceed the required minimum outdoor ventilation requirements for each space. To do so, engineers should consider improved technologies for heat recovery and energy wheel transfer.

ODOM: Current best practice, during planning and design, includes independent technical peer reviews of the envelope and HVAC designs at several stages, including early design development and later during the construction drawing stage. Many HVAC-related problems can be identified and resolved at these stages.

BAKER: The green building movement has certainly provided a start in addressing these issues. Selecting low-emitting furnishings and finishes and assuring compliance with ASHRAE Standard 62 can make an enormous difference, especially during initial occupancy, but there is so much more that can be done. In my experience, the input and involvement of a seasoned IAQ professional, from design intent through 12 months post-occupancy, can pay real dividends in reduced callbacks, improved occupant performance and avoided costs for remedial action.

SCHEIR: As Mr. Baker notes, it's important to follow ASHRAE design guidelines to maintain relative humidity below 60%. Mold requires a humidity level of 30% or higher to proliferate. Other common strategies include keeping the building under positive pressure to prevent water infiltration and eliminating obvious sources of moisture such as leaky roofs, pipes or mechanical equipment.

KEMP: In the case of cooling coils, condensation cannot be controlled, but the growth of mold can. Ultraviolet light C band (UVC) emitters applied to the cooling coils continuously irradiate mold and organic matter, killing it at the source.

Furthermore, humidification systems should be designed to ensure proper steam absorption. Maintaining relative humidity below 65% minimizes the growth of microorganisms. Humidity below 40%, however, irritates nasal and throat membranes, in addition to increasing static electricity, which can affect the performance of electronic

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equipment.

The key to proper humidification—and elimination of condensation—is absorption. Steam-dispersion units installed in ducts or air-handling units provide rapid, drip-free absorption. When humidification steam is released into the air, it cools and condenses into white mist. As the mist migrates away from the point of release, it gradually evaporates into a gas. If allowed to contact solid surfaces before it evaporates, the gas tends to condense and pool as water, and ultimately causes microbial growth. So, when designing and installing a humidification system, there must be a sufficient length of straight, unimpeded duct downstream of the dispersion unit. This allows steam to evaporate before condensing on coils, dampers, fans and other objects.

CSE: What more can be done to educate the building community about the dangers of poor IAQ?

BAKER: I think that the familiar low-bid delivery process, the shortage of experienced craftworkers and the array of new construction methods and materials all make it difficult to effect a meaningful focus on the health and safety. As cognizant authorities, the U.S. EPA, the National Academies, OSHA, NIOSH [National Institute of Occupational Safety and Health] and various state health departments have helped tremendously by publishing IAQ-related information based on good science. At the same time, the media has actually set us back by creating undue concern over so-called "toxic mold." Ultimately, the science gets lost in the hype and confusion.

SCHEIR: That's true. There's widespread awareness of the existence and dangers of poor IAQ. However, many people do not understand the true causes of poor IAQ and the corrective measures that should be taken. Remedies being offered to the public are sometimes of limited value—and some are downright dangerous. The industry needs to address this information gap with broader educational programs and greater consideration for new control technologies.

LIETTE: There's a ton of data in support of the effects of adequate ventilation on IAQ. Further, continuing studies are denoting better air distribution paths that can positively impact the the occupied space. System approaches, such as displacement ventilation, are enjoying renewed favor among engineers. Studies and research also exist that show improved learning abilities for students in classrooms that are adequately ventilated.

ODOM: When it comes to educating construction professionals, many recognize potential problems but believe that they won't happen on their projects. What seems to compound these problems is that the solutions often involve so many parties—contractors, architects, mechanical engineers and owners—and must sometimes be implemented over an extended period, sometimes several years. And finally, in industries where the staff turnover rate may exceed 20% per year, the institutional knowledge of mold issues is often nonexistent.

KEMP: Poor IAQ continues to be a topic of interest for owners and managers. However, decisions to implement anti-mold and improved IAQ design strategies are often code and standard driven. At this time, mold management on cooling coils is still not a code requirement.

CSE: How do you keep energy consumption in check when heavy emphasis is being placed on IAQ?

SCHEIR: There is a long-standing misconception that energy conservation and good IAQ are conflicting goals. In fact, proper use of UVC technology advances both goals.

> There's a long-standing misconception that energy conservation and good IAQ are incompatible goals, but in fact, some technologies, such as UVC, can be used to effectively advance both of these goals.

The reason is quite simple: A/C coils bathed in UVC light stay in "as-built" condition because they are continuously cleaned of the mold and organic buildup that impede efficient operation. UVC thus lowers HVAC energy costs by improving heat transfer and increasing net cooling capacity. HVAC energy savings of up to 20% are common and have been well documented in commercial and institutional buildings.

BAKER: I agree. Improving IAQ and conserving energy don't have to be incompatible. Proper air sealing and insulation techniques, for example, reduce the likelihood of condensation and heat loss. The growing popularity of ground-source heat pumps and an array of energy-recovery systems that intelligently reclaim both latent and sensible heat provide adequate ventilation and humidity control while keeping operating costs in check.

KEMP: Readers need to keep in

mind that increased energy consumption is not necessarily the result of mold prevention. In the case of mold on cooling coils, energy consumption increases as mold growing on coils decreases airflow and system performance.

In the case of humidification, systems that use gas vs. electricity can dramatically reduce energy consumption, sometimes reducing operating costs enough to allow the system to pay for itself. Furthermore, building owners will continue receiving energy savings over the life of the system.

CSE: Have codes and standards regulating IAQ levels become more strict in recent years? Are regulations continuing to evolve?

SCHEIR: Yes, regulations have continued to become more stringent as more local building codes have adopted ASHRAE standards for design. Unfortunately, "sick building" and mold litigation have been the main driving force behind this trend. ASHRAE is continuously updating its design standards, and it is likely that codes will continue to evolve accordingly.

LIETTE: The expectations of codes and standards have increased, which challenges us to truly evaluate our approach to design and become a bit more creative in our solutions. The resulting condition of occupied spaces has improved and, in the case of school facilities, learning and testing results of the students have improved. New research has driven a better understanding of space conditions and the impact on occupants and improved regulations, codes and standards. System designs will continue to improve as the expectations of the code and community evolve and grow.

BAKER: Frankly, I think some of our building codes are in need of serious overhaul. In some cases, they've simply not kept up with advances in construction methods and materials. In others, their very foundation relies upon incomplete or inadequate research. Current requirements in many jurisdictions for attic ventilation and "warm-side vapor barriers" are but two of many examples.

In contrast, the industry standard for ventilation in commercial buildings, ANSI/ASHRAE Standard 62.1, recently took a significant step forward by incorporating code-enforceable language and clarifying its application to the design process. Although the revised Standard 62 appears to be more complex, its calculations are, in most situations, more straightforward, and a detailed user's guide will be issued soon.

It's unlikely, however, that we'll see regulations on acceptable levels of airborne mold or mixtures of organic compounds any time soon. The technical challenges in conducting the research needed for such numerical exposure limits may simply be insurmountable, especially in light of the lack of available funding. In the absence of a regulatory framework, a combination of technical disciplines and a liberal dose of common sense hold the best promise for protecting and improving the quality of the indoor environment.

(For a discussion of ultraviolet C ban technology and a white paper on IAQ and ventilation, go to the HVAC community at csemag.com.)

Steril-Aire, Inc.
800-2STERIL or 818-565-1128
Email: sales@steril-aire.com
Web: www.steril-aire.com