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Microbiology Laboratories

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Steven Caulfield, PE, CIH

President at Turner Building Science & Design, LLC

Building Science, Moisture & "The Green Book"

AIHA's Recognition, Evaluation and Control of Indoor Mold

This week welcome back Steve Caulfield, P.E., CIH for part 2 in our series on the AIHA's second edition of "Recognition Evaluation and Control of Indoor Mold" aka The Green Book. This week we discuss Building Science & Moisture with Steve and he will include some case studies to illustrate the key points.

Mr. Caulfield has over 30 years of experience in mechanical engineering, industrial hygiene and indoor air quality studies. Mr. Caulfield is skilled in the design and evaluation of heating, ventilating, and air-conditioning (HVAC) systems and their relationship to complex indoor air quality problems. He has provided HVAC design and commissioning services for healthcare, educational, and commercial facilities. He has conducted indoor air quality evaluations for both new construction and existing buildings.

Steve was one of the editors of the newly revised Recognition, Evaluation and Control of Indoor Mold aka the "Green Book". He also volunteers a lot time industry organizations such as ASHRAE, MIAQC and ISIAQ.

Nuggets mined from today's episode:

Steve has an engineering education. The majority of his work has been in industrial hygiene. He got his start analyzing asbestos by microscopy. He was on call 7/24. He worked on many crappy worksites, crawling in tunnels and the worst one was doing an asbestos inspection while walking on wooden

planks suspended from overhead pipes by duct tape.

Steve chuckled at his self-described role in the Revised Green Book, *'the fall guy who reviewed the inspection and building science chapter.'*

The 4 most important building science principles those doing IEQ work need to understand are: Liquid flow by gravity, capillary suction movement, movement of water vapor by air movement & water vapor diffusion by vapor pressure differential The most important and hardest to understand is likely movement of water vapor by air movement.

CASE STUDY 1

Newly renovated school in North Carolina. The new addition was approximately 3 X times larger than the two original schools buildings. $500K was spent on adding dedicated dehumidification. The air handlers were shut off at night, when the air handlers weren't working the dehumidification system wasn't working. Big shout out to TSI, as a TSI Q Trak was set up in a classroom and allowed to run overnight. The reading showed the temperature remained the same all night and the RH increased.

Findings & Observations:
This is hot and humid North Carolina in the summer. Tails of the roof joist extended from the exterior of the soffit. The soffit was a "black box". Upon further examination there was no air sealing. The top of the exterior block wall was open. The outside perimeter of the building was ¼ mile long and every 3 feet there was a hole. The total square footage of the "hole" equaled 2 garage doors. They then did the fancy stuff (e.g. smoke testing, blower door testing, etc.) they were paid to do.

The Fix:
A $100K project using fire stop air caulking and spray foam insulation

Mold measurements do not answer the basic questions and commonly result in overreaction or underreactions. The real question is what do the results tell us? It's best to develop the hypothesis first before testing/sampling. Then learn whether or not the testing/sampling confirms or denies the hypothesis.

Numbers don't mean anything when you test first without a hypothesis. The numbers require explanation. It's better to seek possible/probable moisture sources first and then test in a manner to quantify the moisture sources.

CASE STUDY 2

Steve commonly is asked to evaluate and commission HVAC systems. You can't always trust the information on the control screens. Steve gave an example of remotely monitoring two 2 year old air handlers. Three separate pieces of data on the control screen said that the fresh air dampers were open. When he made his site inspection he found that the dampers were both sealed closed. The whole school wasn't getting any fresh air!

CASE STUDY 3

Unit Ventilator. Air is drawn in through the bottom and exits through the top. The example he showed wasn't getting outside air due to failure to understand physics.

School ventilation and Covid is a huge opportunity.
Steve has inspected a school HVAC systems built in the 1990s which was designed for 5 CFM per person.

School ventilation and Covid has become a politicized.
Billions of dollars of funding approved for fixing school HVAC systems hasn't been spent.

Recommendation for superior ventilation is good. To save time and get schools open sooner; Steve suggests rather than indiscriminately replacing all existing HVAC systems in schools, each system should be evaluated for system condition and proper operation prior to being replaced.

Up and coming issues:
Indoor chemistry researchers are looking at ionization devices. $60 million has been spent recently on ionizers in schools. The marketing for these devices has shifted away from chemistry to physics. "Ionizers work by creating beneficial ions that magnetically attract bad ones." These devices

actually release protons and electrons and create chemical reactions in the air, no one knows what the results are. Manufacturers only measure what they want to measure. These devices create new chemicals, we can't simply "un-generate" this new matter. He reviewed a test report that showed that a device removed 99% of Covid from 1 cubic foot of air in 30 minutes, it would take 4 months for the generator to remove Covid from a large room.

Bring in outdoor air low and slow. Displacement ventilation uses heat in the space from occupants and equipment to drive airflow. Room temperature air is brought in low, shoots up the body and everything bad goes up and out.

Uncontrolled air movement is dangerous compared to vapor diffusion.

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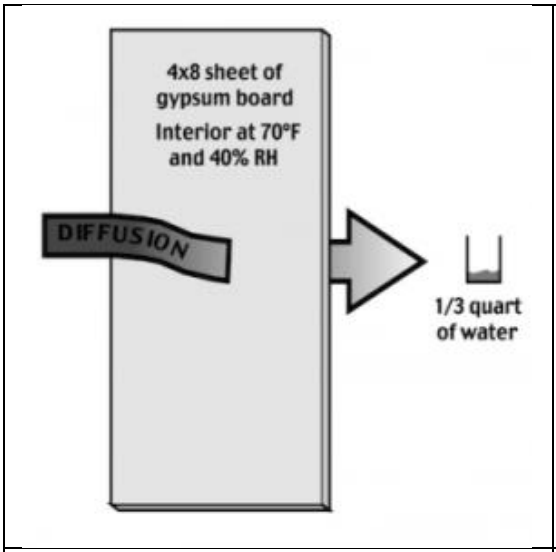
<td> 
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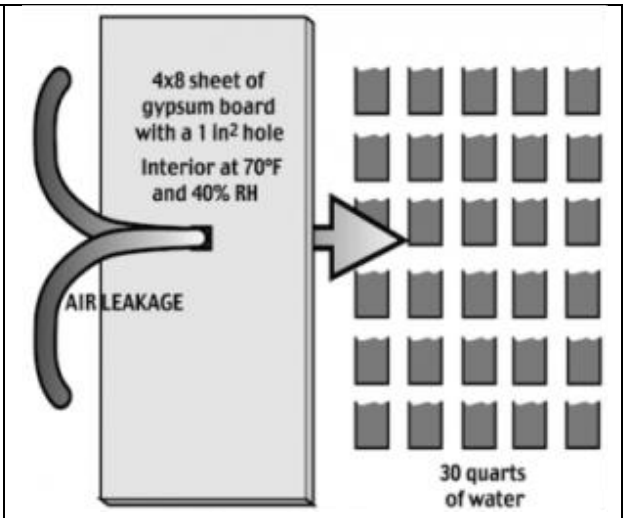
<td> 
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<td>Amount of potential water from vapor diffusion.</td>
<td>Amount of potential water introduced by an air leak of a 1″ hole.</td>
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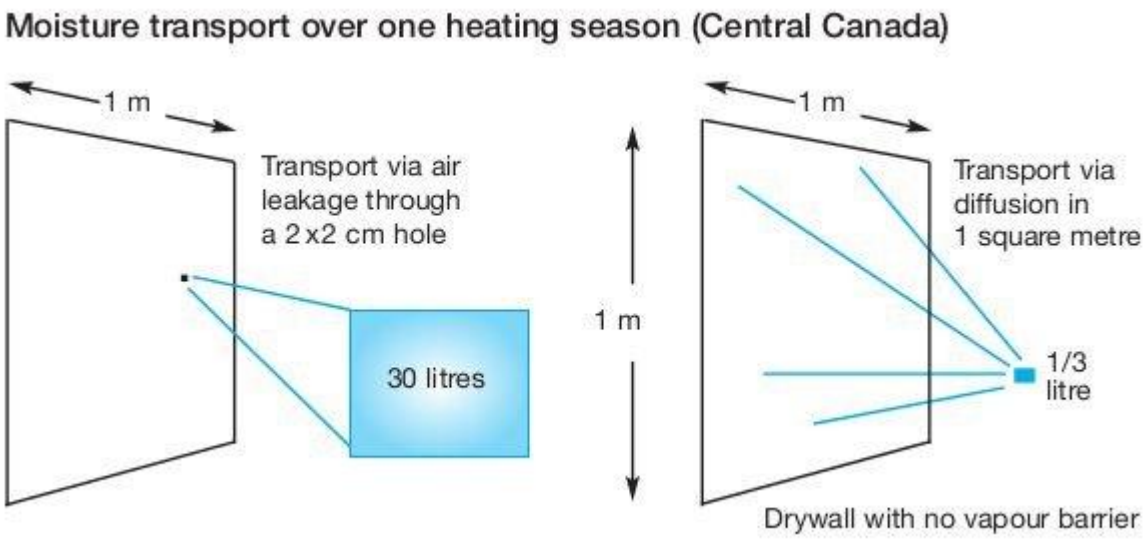
These diagrams from Joe Lstiburek's Builder's Guides are a great visual representation of why vapor diffusion is *almost irrelevant* compared to uncontrolled air leaks. Air-leakage wastes money and rots homes.



Source of graphic ecohome.net

Comments from the audience:

- Thank you Steve for bringing in the ”dwell time” for efficacy!
- Great show!!

Z-Man Signing off

Trivia question:
Name the written work in which Holden Morrissey Caulfield, on e of the most important fictional characters of the 20th century first appears in print?

Answer:
“I’m Crazy”; Answered by: John Lapotaire, Florida Indoor Air Quality Solutions

Notes from Radio Joe:

I received an email after the show and would like to share some important thoughts from J. David Miller, PhD.

Dr. Miller was senior editor of the original and revised Green Book. He feels

Steve was too modest about his contribution to the revised version.

He added, the Green Book sampling information is there to TRY and ensure that if people do sampling it is in the proper context. Sampling should never be done absent an informed inspection. The majority of the text (80%) focuses on doing that work properly including searching for moisture issues.