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Giving Mould a Cold Shoulder

LinkedIn Article

November 10, 2015

Caoimhín P. Connell
Forensic Industrial Hygienist

THERE is a wonderful Home Inspector in Washington State whom I have known for many years, by the name of Charles Buell. Charles has a very inquisitive mind, and often raises great questions. This morning, he posed the following question:

> *Do particular moulds prefer moisture level over food source or is food source more important to a particular type of mould. Given the same food source would one particular mould be more likely to grow than another depending on moisture level and where would temperature fit in both questions.*

Given the exact same food source, under otherwise identical conditions, altering only moisture, we see a very typical profile develop as seen in the photograph that accompanies this post (below).

Moulds have "habits" and the habit speaks volumes to the inspector who will take the time out to listen. The habit can tell you why a mould is growing: is it due to condensation? Or thermal bridging? Or is it a water leak? Or a construction defect?

I was called to the project to debunk an IAQA "Certified Mold Inspector" who, of course, wanted to spend thousands of dollars in unnecessary samples and "testing" and frightened

185 BOUNTY HUNTER'S LANE, BAILEY, COLORADO 80421
PHONE: 303-903-7494 www.forensic-applications.com

the management company with nonsense about “toxic moulds” and very expensive and unnecessary “mold remediation.”

In the photograph, am in the ground floor bedroom of a condominium.   The apartment was occupied by an illegal immigrant family and the wife had a commercial laundry in the apartment and ran normal domestic machines all day long, resulting in unusually elevated absolute humidity in the air of the apartment.

In taking the photograph, I am approximately one meter below grade. If we had x-ray vision, we would look through the wall and we would see the concrete footer directly behind the drywall. We would also notice that there was no furring strips, and no insulation. The net result is thermal bridging resulting in a uniform cold area with two limits: The upper limit is the top of the footer, on a south-facing external wall. Therefore, once you get above the top of the footer, there is high solar loading, on the south wall which is warming the wall.

At the lower limit, the footer contacts the slab, and acts as a “storage heater” making the bottom a little bit warmer than the middle portion, which is the coldest spot.

Therefore, the only thing that is changing is the thermal profile, and therefore, the relative humidity at the surface of the wall is also changing (even though the absolute humidity in the room is remaining exactly the same). Therefore, there is a dew-point profile that emerges, wherein the dew-point is exceeded most about half a meter up from the slab, and least at the very top of the footer and the bottom of the footer and nowhere at all anywhere above the footer wall.

The organisms therefore have a range of water options from which to choose, and colonize the wall depending on their “water activity” preferences.

Most moulds need readily available water to initiate growth. In mycological terms, water availability is usually given as “water activity” (a*w*). Water activity is expressed as the ratio of the vapor pressure of the water in the air in equilibrium with a substance divided by the vapor pressure at the same temperature of pure water.   Thus, a*w* values range from 1.0 (for free standing water) to 0.7 for hard candy and dried cereals and fruits.

At the same absolute humidity, (such as in the room), the same building material may different a*w* since the surface of the material has different temperatures, and therefore, different dew points.

Water content of a substance is not the same as water “availability.” Two substances with the same water (moisture) content may have very different *aw* values. Kiln-drying wood removes water which is tightly bound to molecular sites such as hydroxyl groups of polysaccharides, amino groups of proteins, and other polar sites, thus lowering water “availability.” Air dried wood does not release that tightly bound water since there is an equilibrium which exists between the water vapor in the air and the movement of water molecules in the substrate called the “water potential” (a complex phenomenon dealing with the entropy of the water molecules that is beyond the scope of this postil).

When water is present in the air, we use the phrase percent relative humidity (%RH) which is the ratio of the partial pressure of water present in the air to the partial pressure of water at saturation for the same temperature and pressure. Therefore, a dynamic physical relationship exists between the %RH and the *aw* and even at 80% there will probably be no mould growth. (Many years ago, in conjunction with folks at the University of Montana, we built Perspex boxes and maintained inoculated building materials at a steady, uniform temperature or 23C and a RH of 90% and did not observe any growth in six weeks).

Now – enter a cold spot like the wall of the bedroom. At the point of the cold spot, in an area with an RH of even 50%, condensation can occur and can exceed the localized buffering capacity of the material, resulting in elevated a*w*. And, if that condition is maintained for a sufficient period of time, the area is hospitable for mould and mould might grow.

So knowing the %RH is only half the story and is like hearing the football score between, say, the Denver Broncos and the Green Bay Packers: "Broncos 42, Packers: (______) - you know the Broncos are winning of course, but you don't know by how much.

However, in the absence of the cold spot (here defined as any surface whose temperature is below the dew-point of the air), there simply isn't enough moisture to initiate growth – even at very, very high RHs. Now having said that, there is a spectrum of growth conditions exhibited by various moulds and some moulds, (such as members of the *Penicillia*) are "xerophiles" meaning that they tolerate "dry" conditions (i.e. a*w* of 0.8) Where the wall is the coldest, there is more moisture and the wet loving organisms colonize (*Chaetomium*, *Stachybotrys*, *Ulocladium*, *Memnoniella*, etc).

Therefore, by knowing the habit of the mould, one can "read" the growth patterns, and better understand the "why" which can ultimately speak to the "fix." The fix and prevention are at the heart of the question.