AEML, Inc.
Microbiology Laboratories

Robert Higgins

Concrete Moisture Inspection: The Fundamentals

Episode: 691

This week we welcomed Bob Higgins to wrap up our Moisture Mob series with a final show on Concrete Moisture Inspection: The Fundamentals. After a series of shows that got into the weeds about concrete we feel it would be good to put together a final show that goes over how to take all the information we have aired and use it in the field.

Robert Higgins has been involved with moisture-related issues in concrete and waterproofing since 1976 and has been developing products for such use since 1980. He was a product development chemist for SINAK. He has expertise in moisture-related concrete issues, having been involved with waterproofing, technical committees, professional groups, lecturing, teaching; and construction defect litigation.

Nuggets mined from today's episode:

According to Bob, while the relationship between concrete and moisture is complex; moisture testing is not complicated water is either present or it isn't. Bob advises to just measure the moisture.

When Bob thinks about water, he ponders possibilities: solid, liquid, vapor, absorbed, adsorbed and bound? According to the 2nd law of thermodynamics; water moves from warm to cool. The capillarity of materials such as cement is dynamic. Capillary action defies physics due to water's adhesiveness. Bound water can be temporary (e.g. ice) or long term.

A common error is confusing moisture movement with diffusion. Example of diffusion:

Two like sized containers are connected by a pipe and shut off valve. The valve is closed, the same amount of water is placed in both containers. Food colorant is placed in one of the containers, when the valve is open the colorant will be transported by the water while the water stays in place. Water transports water soluble materials.

Bad information has been piled upon older bad information. This has resulted in flooring claims exceeding $3 billion per year.

While doing historic building restoration in the UK, Bob was queried about what causes “rising damp” also known as capillary suction. Bob advised that rising damp is more of a problem on the shady sides of buildings and in cold buildings. Salts present in concrete become more chemically active when wet. Salts originate in concrete, then move and reorganize when wet.

According to Bob, the flooring industry has suspended their belief in science and physics. The topic of ionic dewpoint isn’t discussed in flooring industry literature. Example: When table salt is placed on a glass saucer in a room where the RH is 65% nothing happens, if the RH is increased to ≥80% RH moisture will condense due to the salt reaching its ionic dew point. Salts can pull moisture out of the air if the RH is 20%.

Concentrated salts such as 20% sodium hydroxide water solution lowers the freeze point of water. Raising the concentration of salt can increase the freeze point of water to 59°F.

High pH is known to damage flooring installations. RH is a valuable forensic tool.

Bob advises that following water damage, the moisture content of wet concrete should be measured, you want a steady rate of drying and drying should be discontinued when the drying curve flattens. Stop when the curve flattens to avoid over drying. When the curve flattens maintain air movement over the concrete and discontinue dehumidification, then coat the floor. Still air is your biggest enemy.

Keep concrete at least 10 degrees above dew point to prevent concrete moisture absorption.

According to Bob, the desiccants found as byproducts in concrete (calcium hydroxide and sodium hydroxide) are more robust than the desiccants found in desiccant dehumidifiers.

According to Bob, during “concrete hysteresis” the ingress of moisture occurs more robustly than the egress. The concrete is full of salty water and can’t dry. Then grind or shot blast the top layer and use a Tramex meter to check for a drop then you are likely OK. Continue air movement, maintain steady environmental conditions, isolate the concrete from ambient and coat.

Bob isn’t an advocate for vapor barriers next to concrete. The concrete industry knowledge is passed on by rote not practicality.

Your meter must agree with gravimetric testing. By nature, Bob is skeptical and a curmudgeon. Bob became interested in Tramex technology when he found a report prepared by a well respected Finnish testing firm that compared various brands of meters to gravimetric testing. The next phase of testing involved comparing field test results to gravimetric measurements. Tramex technology was aligned with gravimetric testing.

Problem: Mold is growing on the bottom side of wrestling mats resting on a concrete floor. Hypothesis: Moisture and sweat first go into the air and then into the concrete.

If possible, determine the original concrete mix design? Perform a Tramex meter test. If the moisture is elevated, scarify the floor. The pH should be between 9-10. If the pH measures less than 9 there is interference and you aren’t measuring the concrete. Maintain steady environmental conditions.

Bob’s Inspection Toolkit: infrared thermometer, digital thermometer, Tramex meter, and infrared camera when inspecting multistory buildings.

“Moisture hysteresis refers to the phenomenon that, at the same relative humidity, the material experiences a different degree of moisture saturation or level of moisture content depending on its loading history.”
https://www.sciencedirect.com › science › article › pii › S0008884612001597

Hysteretic moisture behavior of concrete: Modeling and analysis

A Minnesota Timberwolves basketball game was cancelled when the court floor became wet when moisture in the ambient air condensed on the floor.

Current standards are based on concrete placed in the 1920s and 1950s. In 2019 new type of concrete was introduced to which old concrete rules do not apply. The new concrete has more alkalinity.

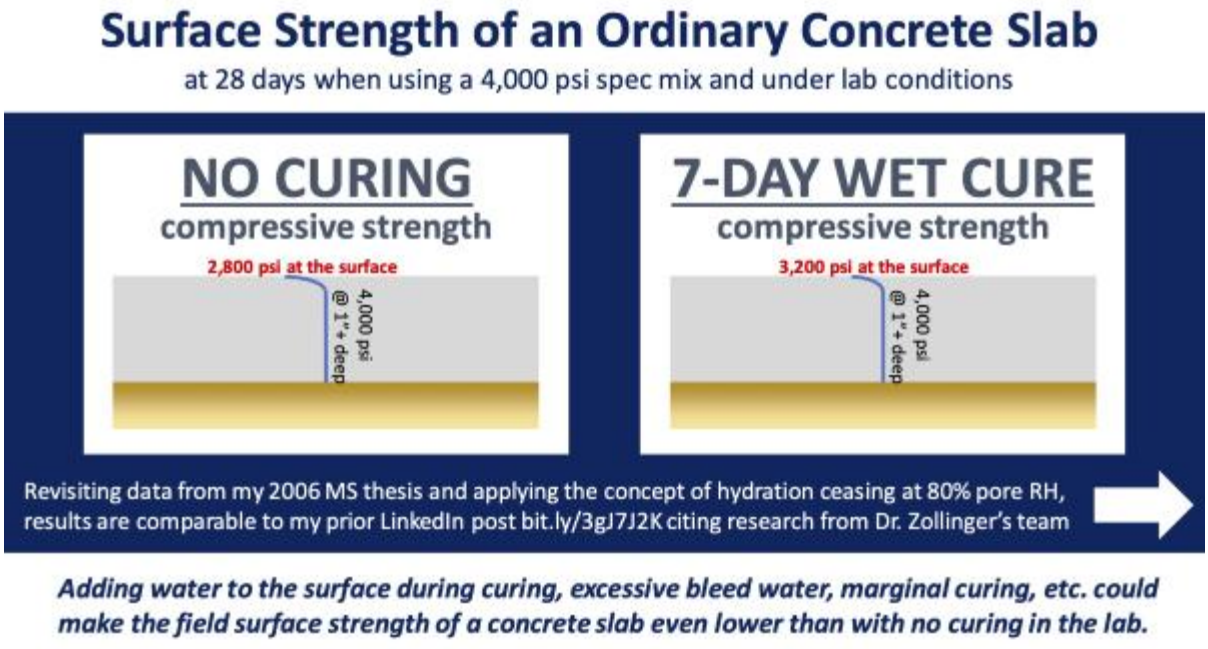
Based upon his testing, Bob found that most floor adhesives are not moisture sensitive after they have cured and set.

Because foot traffic, and occupancy change the dynamics of concrete, Bob advises that the best time to make a site evaluation is immediately prior to installation.

No matter how old the concrete is the top ¾”-1” is what is important. Permeability of materials causes differences in RH. Check the perimeters of rooms, check each different flooring material. “Remember cement is an eager, greedy mouth gobbling up moisture.” We are all familiar with how fallout of airborne contamination (e.g.

dust) gradually builds up in our homes, airborne contamination builds up on cement slabs in the same manner and causes problems.

Each wood specie has its own hygroscopic value. Baselines for concrete hygroscopic values MUST be established.



Don't install hardwood floor directly onto concrete. Concrete is comfortable when wet so a moisture barrier (not poly sheeting) is needed between concrete floor and adhesive.

Z-Man's high pH and high alkalinity explanation for cleaning and restoration folks:
High pH and high alkalinity are different. What makes them different is buffering which is the addition of resistance to pH (think pH reinforcements).
An unbuffered high pH cleaner of 12.5 may be unable to maintain its pH upon exposure to acidic soil and the pH will drop quickly.
Conversely, a moderately alkaline (buffered) cleaner with a pH of 10 resistant to pH change and may cause fiber damage due to prolonged contact.

Nothing scares Bob more than 30-40 year old concrete.

How to tell when you are in over your head? There is high pH reading, high Tramex reading and your fans and dehumidifiers haven't made positive change over several hours. When both are low, you are good to go! (both pH and Tramex readings)

The equilibrium of the transformation between vapor in the atmosphere and water in concrete is known as dynamic equilibrium.

We can confidently add that once installers and manufacturers are taught and understand these basics, moisture problems will not only make sense to them, but they will understand how to avoid them and be able to differentiate an actual moisture problem versus a deficient substrate issue.

The ambient conditions average warmer than the concrete, so moisture tends to accumulate and get absorbed by the concrete.

Here is another bomb....moisture movement as taught is moisture in an open, non-restrained environment. For those who deal with moisture issues, there are two other types of moisture that are generally not known and much less understood by all these "experts": absorbed moisture and adsorbed moisture.

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LINK TO BOB'S ARTICLE ON ALKALINITY

Z-Man signing off

Trivia-

Name the term that is defined as follows: a destructive condition when ground moisture rises into and up a masonry wall via capillary action?

Answer: Rising Damp
Answered by: Larry Steinbronn