The Commercial FLOORING REPORT

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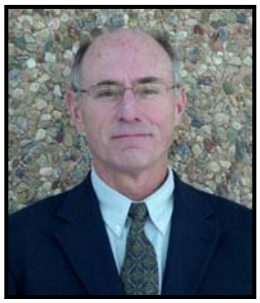
Concrete Testing - Doing It Right



Certified concrete moisture testing technicians will provide better test results.

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By William D. Palmer Jr.

At CONCRETE CONSTRUCTION's first Industry Trends Roundtable in June 2002, the hot topic was moisture coming out of concrete floors and delaminating vinyl flooring, tile, and coatings. During the CEO Forum that followed, recognition of this multimillion-dollar problem led American Society of Concrete Contractors' members to contribute $40,000 to a special fund to address floor moisture and pH. This resulted in the April 2003 Inter-Industry Working Group on Concrete Floor Issues (IIWG) http://www.ascconline.org/PDF/ASCCtoleranceworkshopsummary.pdf that brought together representatives of the concrete and flooring industries for the first time. The IIWG report concluded that “everyone who is involved in designing and constructing concrete floors wants to produce a satisfactory end product.”

Six years later, the challenges remain. The International Concrete Repair Institute (ICRI) http://www.icri.org/ addresses that problem with a new certification program for moisture testing technicians developed under the guidance of flooring expert Peter Craig who is also an associate of LGM & Associates. This program intends to certify that a technician understands the moisture and pH tests, knows how to conduct the ASTM standard tests, and has the ability to interpret the results. ICRI's program goes one step further by helping technicians to use a consistent approach toward procedures in the test methods that are less than crystal clear. The ICRI program will provide those who need and use moisture tests greater confidence that the test results they are paying for are reliable and consistent.

Why test for moisture

Fresh concrete for floors always contains more water than hydration consumes. This water of convenience comes out of the slab, first as bleed water and then by drying. If an adequate vapor barrier lies directly beneath a slab on ground, eventually the slab becomes dry enough for safe installation of flooring materials. The problem has been that eventually is not soon enough for most construction.

One caution here is the assumption of an effective vapor barrier directly beneath the slab. A below slab vapor barrier, as Peter Craig writes in a March 2004 CC article titled “Vapor Barriers: Nuisance or Necessity,” is both a nuisance and a necessity. It is a nuisance when it increases curling, but a necessity in order to seal the floor from ground moisture. Then the actual moisture rate within the slab never increases. “Today below-slab moisture protection is commercially available to as low as 0.01 perm with little if any premium to that of conventional materials of far greater permeance,” writes Craig. “An effective, low-permeance vapor barrier or retarder is necessary to protect many

modern floor coverings, adhesives, coatings, and building environments, and to conform with published guidelines from the flooring industry."

Concrete slabs initially possess an internal relative humidity (RH) of 100% from top to bottom. As the slab dries from the top down, assuming it is a slab on ground with a vapor barrier, the RH at the top of the slab becomes less than at the bottom. If, however, an impermeable covering is installed on top of the concrete, then all drying stops, the moisture in the slab redistributes, and the RH will again be the same from top to bottom—only less than 100% depending on how much drying has taken place. But in order to get a successful floor covering installation, it must be known what the internal RH of the covered slab will be before it is covered. Research shows that the RH of an uncovered slab at 40% of the total slab thickness is approximately the same as the equilibrium RH the slab would have when covered. In other words, for a 5-inch uncovered slab with an effective vapor barrier below, the RH at 2 inches beneath the surface represents the covered equilibrium RH.

How to test for moisture
Many methods have been developed to test for concrete moisture, both within the slab and through the amount emitted from the surface. A commonly used method not covered by the ICRI certification is moisture meters. These devices can be useful for finding areas of higher surface moisture but should not be used to obtain a quantitative value of moisture or to indicate whether a slab is dry enough for floor coverings.

The three moisture tests in the ICRI certification include the calcium chloride test for moisture vapor emission rate (MVER) of a slab, the slab internal relative humidity test, and the surface relative humidity test. To allow the slab to reach equilibrium with the building's ambient conditions, all require the building's environment to be constant for at least 48 hours prior to testing— ideally at the service temperature and humidity expected during normal operation.

Calcium Chloride Test (ASTM F 1869). This test measures the MVER of a slab—that is, the amount of water vapor coming out of the slab's surface. This test is used widely to qualify a floor as ready for floor coverings. There are a number of companies that manufacture kits for conducting this test. All are conducted in the same way, relying on a small dish of bone-dry calcium chloride placed beneath a plastic dome that is sealed to the concrete's surface for 60 to 72 hours. This creates a closed environment on the concrete surface, and the CaCl absorbs all moisture emitted from the concrete. The MVER value is expressed as the pounds of water coming from 1000 square feet of surface area in 24 hours (typically abbreviated as pounds). Flooring and adhesive manufacturers usually require an MVER level of 3 to 5 pounds prior to flooring installation.

Before placing the test kit, ASTM F 1869-04 states that a 20x20-inch area should be clean and exposed to the conditions expected during normal operation of the building. Exactly what constitutes clean and exposed currently is open to interpretation. The ICRI certification, however, requires the technician to lightly dry-grind the surface, thoroughly vacuum and then wipe the surface with tack cloth until it is clean.

Although thousands of MVER tests are performed each year, many experts do not feel that the MVER result alone provides sufficient information because it only measures the conditions in the top 1/2 inch of the slab. Howard Kanare, senior principal scientist, CTL Group, Skokie, Ill., notes in an article in CC's http://www.ctlgroup.com/staff_detail.asp?consultant_id=42 2007 Special Floors Issue that the test is "unreliable, capable of producing both false high and low results, and dependent on ambient temperature and humidity, water-cement ratio, use of lightweight aggregate, the presence of curing compound, how hard a floor was troweled, and how the test site is prepared."

The disposable Wagner sensor never requires recalibration and equilibrates quickly to the RH at the 40% depth level in the slab—indicative of the equilibrium RH of the slab once covered with flooring.

High moisture levels and high pH can lead to degradation of flooring adhesives.


Adhesive Degradation

Internal Slab Relative Humidity (ASTM F 2170).

Most slab experts consider the F 2170 RH test to be the most reliable test available today for determining the overall moisture condition of a concrete slab. As with the CaCl test, the results are only meaningful when there's an adequate vapor barrier directly beneath the slab to completely close it off from sources of new moisture. The standard requires three tests for the first 1000 square feet of floor area and one more for each additional 1000 square feet. A hole is drilled dry, thoroughly cleaned, and vacuumed of all dust. ASTM F 2170 simply says to "remove dust from hole using a vacuum cleaner." The ICRI technique involves multiple brushes and vacuum attachments to ensure no dust is left in the hole that could interfere with moisture transfer. A hole liner that seals the sides of the hole to the bottom then is inserted and left in place for 72 hours.

All of this is intended to make a depth-specific measurement of the humidity in the concrete at 40% of the slab depth. If everything is sealed properly and allowed to equilibrate, the goal is accomplished. A relative humidity probe is used to measure the RH of the air at the bottom of the hole and that indicates what the RH of the slab would be if impermeable flooring was installed. If that number is below the specified value (about 75% for most floor coverings), installation can proceed with a level of confidence.

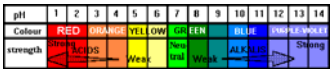
Various devices are used to perform this test. The ICRI certification program includes tips for getting the best results from each of the different methods.

Slab Surface Relative Humidity (ASTM F 2420).

Think of this test as a combination of F 1869 and F 2170. As with the CaCl test, a dome is used to create a closed environment on the concrete surface (albeit one that is insulated to minimize the influence of ambient conditions) and as with the internal RH test, an RH meter is used to measure humidity. This is a relatively new test, and values of acceptance haven't been established. The best use may be to test the effectiveness of surface-applied moisture mitigation systems intended

to reduce MVER to acceptable levels. ICRI has included this test in its certification program because there is an approved ASTM test method, although its use is relatively uncommon at this time.

pH testing (ASTM F 710)



High pH levels at the surface of concrete can degrade many adhesives, especially the newer low-VOC varieties. Fresh concrete has a pH of around 12.5. As the surface carbonates through a natural reaction with atmospheric carbon dioxide, the pH drops to about 8.5. However, this carbonated layer is thin (only about 1/8 inch) and is easily removed by surface preparation methods, revealing higher pH concrete below. F 710 cautions flooring installers about overly aggressive surface preparation, noting that if the carbonated layer is removed, “Additional pH tests, waiting time, application of patching compound or underlayment, or a combination thereof, might be required.” The normal acceptable pH range specified by adhesive and flooring manufacturers is 7 to 10.

Testing for pH can be done using three different methods: pH test paper, pH pencils, and pH meters.

The ICRI program covers only pH paper and pH meters because these techniques are much more commonly used than pencils. There are two ASTM standards that cover pH testing: F 710 and F 4262; however, the ICRI program only includes the method in F 710 because the F 4262 method does not indicate a wetting time, which has been found to be critical. The wide-ranging F 710 standard has drawn criticism that it unfairly blames the concrete contractor for problems associated with resilient flooring installed on concrete and attempts to impose unreasonable limits on water-cement ratio. Some of this criticism is valid, although most of the objectionable statements are in the non mandatory appendices.

To test for pH, a small area is lightly sanded so as not to remove the carbonated layer, but only to clean the surface. Typically a pH test is conducted at every location where a moisture test is performed. Enough distilled water is placed on the slab to form a 1-inch puddle and the pH is tested at 60 seconds ± 5 seconds. This is critical, because the pH can increase significantly if the water is allowed to sit for a longer time. The same procedure is followed whether pH paper or a pH meter is used.

ICRI certification

The ICRI certification program had a trial run and

critique session in April 2009. The first public session was held in the fall of 2009 in Chicago. To become certified, a technician will be required to take a training class, pass a written examination, and pass a performance examination. During the performance exam, the various CaCl test kits and RH equipment will be available so that technicians can choose the equipment they plan to use in practice.

To become certified, the applicant will be required to properly perform multiple tests.

During the certification performance exam, students will need to know how to grind the surface in preparation for a CaCl test.

Soon, flooring and adhesive manufacturers will be able to specify that pre-installation moisture and pH tests be performed by ICRI Certified Floor Moisture Testing Technicians. Job specifications also may require ICRI certified testing. This will lead to greater confidence in the test results and greater success with flooring installations. As the Inter-Industry Working Group noted six years ago, the goal really isn't to blame someone else for a floor failure but to prevent that failure in the first place.

The issue of moisture in concrete substrate continues to plague the floor covering industry with installation failures easily reaching into the hundreds of millions of dollars each year. These are not problems you want to have. The easiest way to be responsibly green is to keep the flooring on the floor and not waste it by failing to correctly test for moisture.

At LGM & Associates our concrete specialists are certified and helped to write the book on this issue. If you have a problem or need a question answered call us – we can help you.

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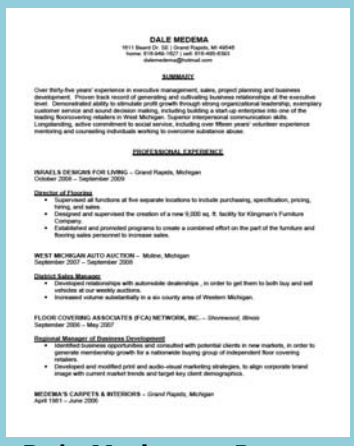

Dale Medema - Resume

Postings are at CFR's discretion

Concrete, Moisture and Flooring Failures

"This is just to formally thank you for consistently providing the most definitive expertise and thorough technical information available anywhere on any and all topics regarding floor covering products and their installation. Your technical conference on concrete vapor emission last week was your best yet and clearly stands head and shoulders above a number of hit and miss attempts by others at this same topic. As you well know, concrete vapor emission and elevated chemical pH has, in varying degrees, plagued all floor covering manufacturers, installers, and too many of our customers for many years. Unfortunately, it's also a topic that over the years has generated much misinformation and, subsequently, ineffective, snake oil-type "cures." Thank you for bringing together the most credible experts available anywhere to provide information that was logical, concise, and well founded in research, evidence, and real world experience. The speakers were engaging and equipped us all with valuable tools that will immediately serve our companies and our customers. Thank you."

Chris Drummond
Vice President Customer
Quality Assurance Bentley
Prince Street

This one day seminar can be held at your facility. The cost of this seminar is minimal considering the educational benefits it will bring to your company. We look forward to hearing from you.

An In-Depth presentation for identifying and solving moisture-related problems with concrete floors.

Presenters:

Peter Craig – Concrete Constructives

Sim Crisler – VP LGM and Associates

- Moisture sources, movement, & misconceptions
- Below slab vapor barriers/retarders
  Nuisance or necessity?
- Moisture Testing
  What works, what doesn't and why?
- Sub-Floor preparation
- Underlayment and levelers
- Adhesive Choices
- Is pH an issue?
- Why won't the concrete dry?
- Moisture mitigation
- Who is to blame?

Contact Anita Drennon for your registration form or visit our website:
lgmandassociates.com
Email address:
lgm_anita@optilink.us
or
Phone (706) 370-5888

ADDITIONAL TESTIMONIALS:

- "Many seminars in our trade today offer the same or near-same subject matters and information sharing that has been repeated and shared many times over many years. Be it carpet cleaning methods, industry installation standards, indoor air quality, GREEN, etc., ours is an industry that is deep and replete with a lot of information that has been talked about many times, reviewed, touted and sometimes trashed, hurrahed and hackled. Not so with the recent LGM Moisture Seminar. Lew Migliore and his associates brightened their astral burn by making certain that when their seminar was completed the participants knew more about concrete, moisture, alkalinity, moisture vapor barriers/retarders, floorcovering adhesives and plasticizer migration in two and a half days than all that Moses learned during his forty years of wandering. And he did so because of both the knowledge and messianic qualities of the four expert speakers he had on board to lecture on their individual areas of expertise.

  LGM events are all about learning, cooperating, conciliation and bridge building. They are historically known for the quintessentially good quality of the information provided. Spin Masters beware. The information offered here will leave your lip service silenced and your credibility withering on a vine."
  Mark Johnston – Beaulieu of America – Technical Services

- "Congratulations to LGM on your concrete and moisture seminar. I have been in the flooring industry many years and this is one of the most important and educational seminars I have attended. The instructors were all very knowledgeable. The information I received was on the cutting edge of Technology. I was thrilled that FCICA sent me the information on the seminar. I would urge anyone Involved with the installation of textile or resilient flooring to attend this seminar. The information I received will give me a much better opportunity to guide and direct my customers on their flooring needs and problems. The only regret that I have is that there were not more flooring contractors in attendance. The information I received will also help me protect my company from flooring issues that were never my fault to start with. Again great job !" **G.Fred Acton, Acton Flooring Inc**

LGM and Associates

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