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Concrete Moisture Testing Update

by Christopher Capobianco

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No matter where I go and what group I speak to, there is always an interest in concrete problems – how to prevent them, how to test for them and how to fix them when they happen. This year I've been presenting a one hour seminar, "Concrete Moisture Testing Update" that I'll be presenting again at the FCICA Midyear meeting in Boston on September 29.

A big topic of conversation in the industry for the past several years has been *the Floor Covering Industry White Paper Position Statement on Moisture Emission Testing**. Here are some key excerpts; "It is unreasonable to expect a general contractor, concrete contractor or a flooring installer to have sufficient expertise to anticipate and ask the proper questions for evaluation of potential concrete/flooring problems...Flooring contractors should be made aware of test results, as all flooring manufacturers have placed upward tolerable limits of moisture vapor emission for the installation of their products...However, flooring contractors' expertise should, by requirement, be limited to flooring materials and their installation... It is therefore our recommendation that concrete moisture vapor emission testing be performed by qualified independent agencies."



The ASTM F 2170 Relative Humidity probe method allows testing for moisture inside the concrete slab. (Photo by Christopher Capobianco)

As time goes on and the design and construction industry understands the importance of independent testing, hopefully we will see less testing being done by installers and more done by independent agencies. For some insight from an independent agency, I asked Lee Eliseian, president of Independent Floor Testing & Inspection (IFTI), "What do you find is the biggest challenge in getting moisture testing done correctly?" Mr. Eliseian replied, "Often, concrete slab moisture testing is done by "hit or miss," and testing is done by companies whose primary business is something other than concrete slab moisture testing, i.e., general construction testing laboratories, environmental companies, and flooring contractors. These companies typically are already involved with other aspects of a project, and for convenience are asked to perform this process.

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Moisture testing typically makes up less than 1 percent of their annual revenue and often the testing process gets about the same level of attention. We only do concrete moisture testing so we have developed a system that uses qualified and approved local field technicians who we train so the testing is done according to industry standards."

Mr. Eliseian's point about training is well taken. The important thing is to do the tests correctly, "by the book." How can you get trained on concrete moisture testing? For an answer, I asked Ms. Claudia Lezell, co-owner of Flooring Technology Institute (FTI), a technical training and education center, who has been involved with the development of training programs for inspectors for a number of years through her volunteer work as Vice President of Inspections for The Institute of Inspection, Cleaning and Restoration Certification (IICRC). "The IICRC has developed a hard surface inspector training and certification program", Ms Lezell explained, "and the prerequisite course is "Introduction to Substrate/Subfloor Inspections (ISSI), a three day course including a 160 question exam that is open to anyone who wants to learn this material, whether or not they plan to work as an inspector." There are a few schools around the country offering this training, and Ms Lezell explained that "FTI offers the IICRC's three day ISSI course and also our own one day course, "Moisture Testing and Investigation Day."

The Latest Test Methods



To run the ASTM F 2170 Relative Humidity probe method, first drill a hole to 40 percent of the concrete depth. (Photo by Christopher Capobianco)

Here are six methods for concrete moisture testing. The first three should never be used to make a decision about whether a concrete slab is ready to have a floor installed.

The senses test: ("It looks dry," "It feels dry" and/or "It smells dry"). Many jobs go forward based on this test method. Unfortunately, you can't see, feel or smell moisture coming out of a concrete slab, so using this method to decide if a slab is ready is just plain foolish.

The plastic sheet test: Many of us have used a plastic sheet taped to the floor as a way of testing for moisture. Tape down the sheet, come back in a few days and if it's dry under the plastic, lay the floor. The problem is that this method is influenced by atmospheric conditions and is not accurate. I once saw side by side tests on a slab that had very high readings on the calcium chloride test but the plastic sheet right next to it was completely dry. If you use a plastic sheet, beware! Dry may not be dry!

Moisture meters: I am amazed how often I get calls from someone who gives me a concrete moisture meter reading and asks if it is okay to install a resilient floor. Concrete moisture meters are a "spot check" at a given moment in time, but they give no indication of long term moisture conditions and there are no flooring or adhesive manufacturers who will accept this method as a "go or no go" test for installing resilient flooring over concrete. Meters are useful for testing the dryness of gypsum underlayments, for trouble shooting of concrete related flooring failures, and to identify locations in the concrete that are "wetter" than others so they know where to place their moisture tests.



The ASTM F 2420 Relative Humidity "Hood" Method is new to the United States and works in a similar way to the F 2170 method, but without drilling. (Photo courtesy of Tramex)

The following three methods are ASTM Industry standards** that have been developed to provide accurate and repeatable results.

Calcium Chloride Test Method. ASTM F 1869, *Standard Test Method for Measuring Moisture Vapor Emission Rate (MVER) of Concrete Subfloor Using Anhydrous Calcium Chloride* is a test that has been around almost 50 years and is widely used but often done incorrectly. The four most common mistakes when doing the ASTM F 1869 test are:

Wrong conditions: The test must be done when the building is at the same temperature and humidity it will be when the space is occupied. If there is no heat or air

conditioning, don't do the test because the results will not be valid!

No Preparation: The F 1869 method calls for cleaning a 20-inch-by-20-inch square at each test site to be sure you are testing bare concrete. This will remove curing compounds, sealers or old adhesive residue. The people who do testing for a living always lightly grind the surface so the slab is completely clean. Failure to clean the slab may result in a false low reading.

No Waiting: ASTM F 1869 calls for a 24-hour waiting period after cleaning before the test kit is placed so surface moisture that was trapped beneath whatever coating was there can evaporate. Failure to wait 24 hours may result in a false high reading.

Too few tests: For all concrete moisture test methods, go "by the book" and do three tests for the first 1,000 square feet and one test per 1,000 square feet after that.

Even when done correctly, the calcium chloride test has limitations because it only measures moisture vapor emissions from the very top of the slab – less than 1 inch down. Because most concrete slabs dry from the top down, they are often dryer at the top than on the bottom, until you cover it with flooring. When these slabs are covered, the moisture down below moves upward, is blocked by the floor covering and trapped in the adhesive layer, turning it to mush.



Proper cleaning of the concrete slab before Calcium Chloride Testing is critical for accurate results. (Photo courtesy of George Donnelly)

Two other methods have been developed that are able to "look deep" into the concrete to see if there is any moisture waiting to come to the top.

Relative Humidity "Probe" Method ASTM F 2170, *Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes* involves drilling holes to 40 percent of the slab thickness – usually 2 -3 inches down. This measures moisture inside the slab, which is thought of as a more accurate way of predicting what will happen in the future. Denise Padgett, Sales &

Marketing Manager for Wagner Electronics, a manufacturer of handheld moisture

measurement devices, explains "Unlike calcium chloride testing, relative humidity probes are less sensitive to fluctuations in ambient air humidity and temperature above the slab." I've noticed that limits for RH tests are starting to show up in manufacturer's instructions installation manuals, and Ms. Padgett agreed, saying "Many areas within the industry are moving towards RH testing. I'm working with several associations who in the next few months will include RH testing in their installation practices and guidelines."



New methods and equipment for Relative Humidity Probe testing are designed to make the method faster and easier to use. (Photo courtesy of Wagner Electronics)

Relative Humidity "Hood" Method ASTM F2420

Standard Test Method for Determining Relative Humidity on the Surface of Concrete Floor Slabs Using Relative Humidity Probe Measurement and Insulated Hood is a

brand new method here in the United States that has been in use in Europe for a number of years. It was approved as an ASTM standard in 2005. It has not yet started to make its way into manufacturer's installation instructions but it may in the future so remember you heard about it here first. Like the ASTM F 2170 method, this test also measures relative humidity, but on the surface instead of inside a hole in the concrete. GE Sensing is a manufacturer of a variety of moisture testing equipment and I asked their Global Product Manager Chris Ranwell some questions about the ASTM F 2420 method. "This test seems similar to the calcium chloride test. How is it better?"

"The hood method measures the amount of free water in the concrete and the calcium chloride kit measures how much vapor is being driven off the surface. One of the reasons humidity testing in concrete is becoming more popular is that these methods are not as sensitive to atmospheric conditions unlike the calcium chloride test kits. The hood method is measuring the equilibrium relative humidity of the concrete in exactly the same way ASTM F 2170 is and is gaining popularity due to the fact no drilling is required."

"Does it have a correlation to the ASTM F 2170 test?"

"They both measure the equilibrium relative humidity. The hood method measures close to the surface and humidity probe tests measure at the 40 percent depth of the concrete. Readings from the hood method tend to be 5 percent lower than with the sleeve method."

The floor covering industry would do well to stay up on the latest methods for moisture testing. Installers should know these methods in case an employer asks them to do one, and also because there will be opportunities for work from these independent testing agencies as more and more testing is done in the future.

Flooring retailers and contractors need to be aware too, and be more knowledgeable than their customers or the general contractors. If there is moisture related floor covering failure and the floor was not tested before



Relative Humidity probes can be used internally for the ASTM F 2170 method or on the surface for the ASTM F 2420 hood method. (Photo courtesy of G.E. Sensing)

installation, then there is a lot of finger pointing after the fact. Even worse, if the testing was done and not done correctly, then whomever did the testing can be held responsible and the costs are enormous.

* Floor Covering Industry White Paper available at www.WFCA.org or call 800-624-6880. ** ASTM Standards available at www.ASTM.org or call 610-832-9500.

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