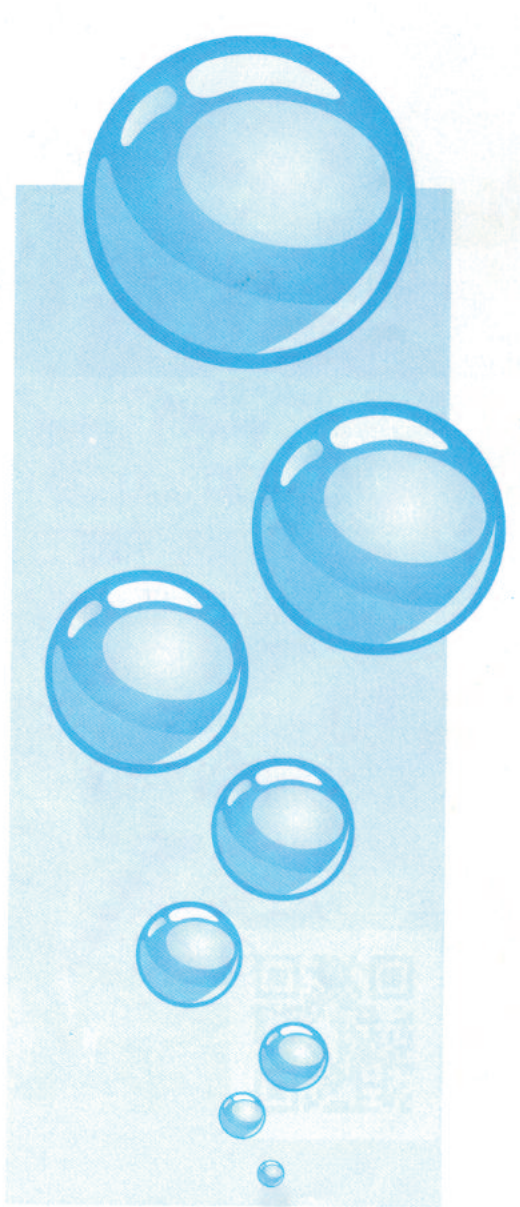
Calcium Chloride and Relative Humidity Testing - Working Together
October 25, 2012

Field Testing for Moisture

MVER and RH, working together

By Lee Eliseian

A new client recently contacted us with questions about concrete moisture testing. They were in the process of evaluating their moisture testing specifications and asked for technical input about the various test methods. Specifically, they were thinking of discontinuing the requirement of calcium chloride testing and relying only on in situ relative humidity testing.



This was a major change for this company - it had relied on the calcium chloride test for years. The change in thinking was brought about by a developing belief that the calcium chloride test is unreliable and, therefore, decision-making based on data generated by an unreliable test method was playing the worst kind of Russian roulette. They were tentative since, to date, their discussions were based on hearsay and not much else. The purpose in talking with us was to either confirm or debunk their thinking. We set up a meeting and a lively discussion ensued, which I will summarize in this article.

We have been involved with concrete moisture testing for many years and we agree there were shortcomings with the calcium chloride test. But we feel those shortcomings have largely been overcome through the years as more and more research has been done, The development of an alternative moisture test method, the in situ relative humidity test, has not made the calcium chloride test method irrelevant but has actually contributed to its validity.

Most qualified professionals agree that the two test methods (the calcium chloride test for moisture vapor emission rate (MVER) and the in situ relative humidity test provide information on two

The in situ relative humidity test also needs to be conducted properly to provide consistent and meaningful results.

different concrete slab moisture conditions. In situ relative humidity testing measures the moisture condition within the body of the slab, and calcium chloride testing measuring the moisture condition at the surface of the slab.

The in situ relative humidity test is conducted according to the test method specified in ASTM F2170, Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes. This measures the relative humidity in the slab at a depth that would be equivalent to the RH that would exist in the slab after installation of an impermeable floor covering. The calcium chloride test, on the other hand, measures the moisture vapor emissions from the surface of a concrete slab. The test guidelines are in ASTM F1869, Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The standard defines its scope as "the quantitative determination of the rate of moisture vapor emitted from below-grade and above-grade (suspended) bare concrete floors."

The calcium chloride test has a long lineage in the United States. The test was first introduced in the 1940's, growing in usage over the decades to a point where its use has become embedded within the flooring industry. During the past 10 years or so its dominance has been challenged by the in situ relative humidity test. Like the calcium chloride test, the in situ relative humidity test comes with a lineage, though not quite as long. The in situ test comes to the United States by way of European researchers and is based on research conducted during the 1990's.

Common Misconceptions

As with any field test, the calcium chloride test has its limitations. A major criticism is it's susceptibility to ambient conditions. A poorly controlled building interior can

The International Concrete Repair Insititute's moisture testing certification program has helped to standardized the way tests are performed.

result in false test results. The current standard calls for interior temperature to be "at the same temperature and humidity expected during normal use." The standard goes on to say "If this is not possible, then the test conditions shall be 75 ± 10° F and 50 ± 10 percent relative humidity."

Note that the in situ RH test method also requires ambient conditions to be at service conditions. Section 9.1 requires "Concrete floor slabs shall be at service temperature and the occupied air space above the floor slab shall be at service temperature and service relative humidity for at least 48 h before making relative humidity measurements in the concrete slab."

For any test to yield reliable results, the test must be conducted within the parameters of either as-built or in-service conditions. The problem isn't that the test is capable of producing inaccurate results; the problem is poor planning on the part of those requesting the test. For example, we were commissioned to do moisture testing on a large, now floor at a major university, but found that doors, windows, and parts of the roof were not yet installed. We notified the general contractor who, in turn, submitted a request for information to the architect. The reply: Just do the test! And believe me, this is not the exception but the rule! Just do the test! The bottom line is simple: in the hands of the uninformed, this

test, or any field test, will do little but satisfy some obscure requirement that testing be conducted not that testing be conducted properly to reduce the risk of concrete slab moisture-related flooring problems.

A second argument against the calcium chloride test concerns surface preparation: Too many tests are being performed without proper subfloor preparation. One can convincingly argue that this is not a problem with the test but is instead a problem with the published standard. Past versions of the test method called for the concrete surface to be "clean and free of all foreign substances." Clean is different things to different people and while some were content to merely sweep away any debris, others used sandpaper, a wire brush, a tacking cloth or a concrete grinder to "clean" the surface.
The 2011 revision has cleared up much of the confusion over the term "clean" by adding some guidance and clarification: "Remove floor coverings or coatings, if present. Lightly grind an area 20 by 20 inches to produce a surface profile equal to ICRI CSP-1 to CSP-2 (see ICRI Technical Guideline 310.1-1997). Grinding should remove a thin layer of the finished concrete but not expose coarse aggregate, unless the surface had been abrasively treated previously."

The final major argument against the calcium chloride test has to do with what it actually measures. The test itself is only able to measure moisture within the upper one-half inch or so of the concrete surface - anything below that remains unknown. And as a floor covering contractor or manufacturer, isn't that what I'm interested in? The condition of the concrete subfloor at its surface?

I've always wondered why this was ever an issue. Common sense says that if you measure the surface of a material, your readings will reflect conditions at the surface. The test standard states as much in section 4: "Use this test method to obtain a quantitative value indicating the rate of moisture vapor emission from the surface of a concrete floor and whether or not that floor is acceptable to receive resilient floor covering." The calcium chloride test never made claims that it measured anything other than the moisture vapor emissions from the concrete surface.

Strengths of the Test

The calcium chloride test has many strengths and its continued importance to the floor covering industry cannot be understated. The greatest argument in favor of the test is its history. The calcium chloride test has provided the floor covering industry with a huge historical store of knowledge and data. This extensive body of data and experience, collected over half a century of use, allows for an instant familiarity with test results. For example, I know through experience that northern California on-grade slabs typically have a moisture vapor emission rate of between 5 and 6.5 pounds. Results outside that range set off alarms and the farther outside my "normal" range, the deeper I dig to discover the reason for the deviation.

This legacy is reflected in the installation requirements of almost all floor coverings and coatings. The requirement that calcium chloride testing be performed before the installation is contained in almost all manufacturer literature, and for a reason. They know the test, they understand the test and they have years of accumulated data of test results and product performance. This is knowledge that will not yield easily - nor should it.

The test is also easy to administer, especially now that the most recently published test standard has removed some of the confusion about test site preparation. The test kits are inexpensive and the investment in equipment is minimal - most flooring professionals already own the tools and equipment necessary to properly conduct a calcium chloride test.
The test itself is flexible and can easily be adapted to test not just for moisture vapor emissions from the surface of an exposed concrete slab (the upper one-half inch) but the test can also be designed to measure for the presence of moisture deeper within the slab. By placing two tests side-by-side, one over the regularly prepared surface and a second over

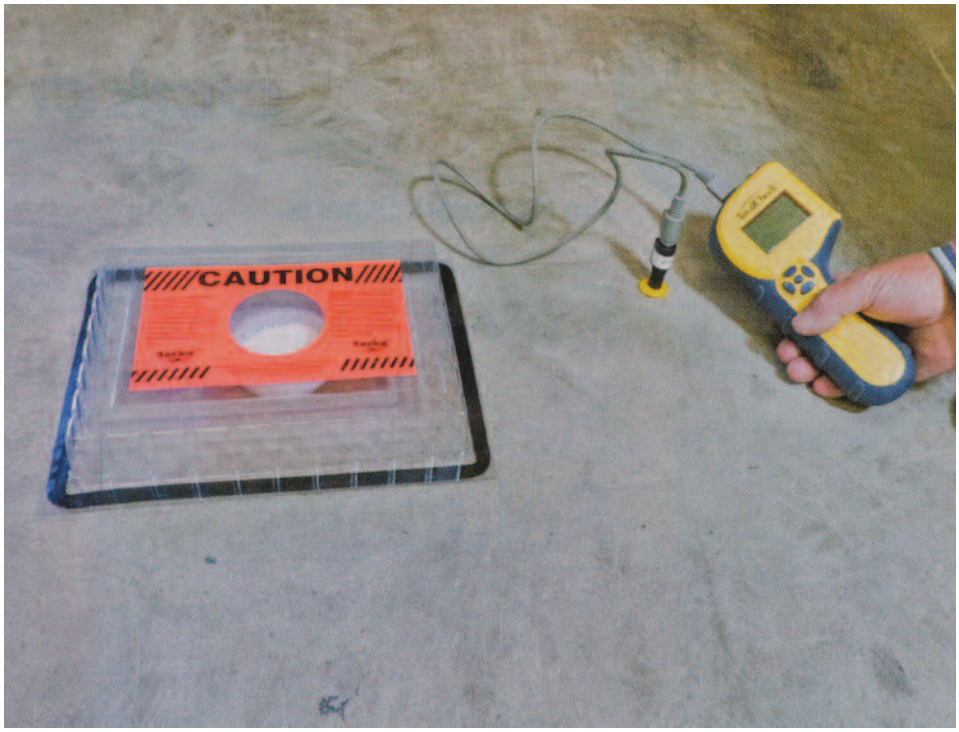
an unvented (regularly prepared surface and then covered with an impervious material) you can develop an excellent understanding of what changes the slab will go through once a floor covering is permanently applied to the surface. (Peter Craig and George Donnelly described this technique in an article in Concrete International in September 2006, "Moisture Testing of Concrete Slabs: When 3 lbs is not 3 lbs."

The real value of the calcium chloride test is the data: how much quantifiable moisture is escaping from the surface of the slab. And isn't that ultimately the question? Isn't that what everyone really wants to know?

The Final Decision

Most professionals in the concrete moisture testing industry have come to the conclusion that the more information learned about any concrete subfloor, the greater the chances for a project's success. Compromising the testing and data collection process by eliminating a valuable testing option simply makes no sense.

If you go to the doctor because you are having a problem with your shoulder, you probably want him to thoroughly understand your condition prior to prescribing a remedy. He may order an x-ray to see if there is an issue with hard tissue or an MRI to see if there is an issue with soft tissue. Because the information from each of these diagnostic processes do not correlate, the doctor would not rely on only one test to understand the patient's condition.



The calcium chloride dome test and the in situ relative humidity test provide fundmentally different information on a floor's moisture condition.

Similarly, there is no established correlation between calcium chloride test and the RH test. The two provide two types of distinctly different and important information about the moisture condition in the slab. The calcium chloride test result provides the moisture condition near the top of the slab where the flooring will be installed and the RH test provides moisture condition within the body of the concrete. To assess the risk of a moisture-related floor covering failure, most professionals want all of the data.

As specialists in concrete slab moisture testing, we feel that the calcium chloride test method provides great benefit to our clients. Its abandonment or relegation to a second-tier status would represent a disregard for years of accumulated data and experience. Currently, there is no replacement for the surface calcium chloride test. We feel that the continued use of the calcium chloride test, coupled with the relative humidity test, paints a more complete picture of the moisture conditions of a concrete subfloor. And giving clients the best information possible to reduce their risk of concrete slab moisture related flooring problems should be the goal of any professional.

Lee Eliseian is CEO, President and founder of IFTI (Independent Floor Testing & Inspection Inc.), the largest floor moisture testing company in North .America.