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## Concrete Moisture Meters and Calcium Chloride Tests: There Are Better Ways to Test Concrete for Moisture

by Christopher Capobianco  
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*Let's Talk Resilient*

As hard as many of us have worked to train and write about the importance of concrete moisture testing, many floors are still installed without conducting any tests prior to installation. If they are, then they are using what I call "the senses test" ("It looks dry," "It feels dry," and/or "It smells dry"), even though you can't see, feel or smell moisture coming out of a concrete slab. ASTM F 710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring says, "All concrete slabs shall be tested for moisture regardless of age or grade level." That means new or old, basement or 50th floor, ALL slabs!

When tests are performed, they are most often just using a moisture meter (which is not accepted by any resilient flooring manufacturers), or they may use a plastic sheet test or the calcium chloride test, often incorrectly. When floors fail because of moisture and the floor wasn't tested, troubleshooters like myself go back to the specifications to see if the architect called for testing. Then, we go back to the flooring and adhesive manufacturer's guidelines — where it is ALWAYS called for. The question at that point becomes who was supposed to test, and/or why wasn't the floor tested? The whole situation gets ugly.



This photo shows a positive result of a plastic sheet moisture test, but doesn't tell how much moisture is present, so more testing I necessary. It's also important to note that a dry result of this test may not necessarily mean the slab is dry. (Photo Courtesy of CTL Group)

In preparing for this article, I searched a number of publications and websites and tried to find some kind of reference to moisture meters as an acceptable method to determine whether concrete slabs are ready to receive resilient flooring. Not one source said "use a meter to make sure the floor is ready" or anything like that. These meters, which are known as electrical resistance meters or electrical impedance meters, are at best a "spot check" of the top surface at one particular location on the slab.

ASTM E 1907, Standard Guide to Methods of Evaluating Moisture Conditions of Concrete Floors to Receive Resilient Floor Coverings, has a section on how to use meters. It says, "Although a high reading...typically indicates high moisture content, a low reading...does not necessarily indicate more than surface dryness, as the concrete may have a higher moisture content below the surface. Conversely, a concrete with



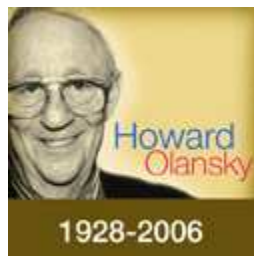
When the old Vinyl Asbestos Tile in this hospital corridor was replaced with Sheet Vinyl, it was assumed that an older building would not have a moisture problem so no testing was done. This shows that ALL slabs need to be tested!

Increasingly, many specifications are calling for independent testing as per the Floor Covering Industry White Paper Position Statement on Moisture Emission Testing, which says, "concrete moisture vapor emission testing be performed by qualified independent agencies." However, more often than not it is the installer's responsibility. It pays to know what is required.

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, even though there isn't a resilient flooring or adhesive manufacturer out there who will accept such a reading for a "go or no go" determination of a slab's readiness to receive flooring. I also get asked what the correlation is between a concrete moisture meter and the calcium chloride test (there is no such correlation).



If it were only this easy...hand-held concrete moisture meters have their place but they are not to be used to decide if a concrete slab is ready for resilient flooring installation. (Photo Courtesy of Tramex)



low moisture content but containing metal fibers could cause a high reading.” This points out the risks of relying on this method exclusively. Metal in the concrete can affect the readings and moisture below the surface is not detected. So, when DO you use a concrete moisture meter?



Proper preparation, including grinding the slab, is often overlooked when conducting Calcium Chloride Moisture tests. If this step is not done, the results will not be accurate. (Photo Courtesy of George Donnelly)

I use it on inspections when I pull up a floor. The meter gives me a “spot check” of moisture and often tells me I need to recommend the client have detailed moisture testing done. I have also heard of cases where meters are used to identify potential “hot spots” where calcium chloride or relative humidity tests should be placed. Meters are useful for testing the dryness of gypsum underlayments. The underlayment manufacturer determines the type of meter and the allowable readings.

My research on the Internet did find a few mentions of the plastic sheet test (a plastic sheet taped to the floor for a day or two). The people referring to this method are, with all due respect, behind the times.

The plastic sheet method is influenced by atmospheric conditions and is not accurate, so wet means wet, but dry may not mean dry. I have seen firsthand slabs that tested “wet” using more scientific methods and “dry” with a plastic sheet. Be careful — this method should not be used.

Most references to moisture testing in the reading I did and in manufacturers guidelines refer to the calcium Chloride Test (ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate (MVER) of Concrete Subfloor Using Anhydrous Calcium Chloride). There is an increasing amount of reference to a newer method, The Relative Humidity (RH) “Probe” Method (ASTM F 2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes).



A properly placed calcium chloride kit: The building climate control system was operational, the floor was ground clean and left for 24 hours and the kit was placed. Adherence to the proper procedure is critical to accurate results.

So what method should I use? ASTM F 1869 The Calcium Chloride Test Method, also known as the MVER test, meaning Moisture Vapor Emission Rate, has been around over 50 years and many adhesive and flooring manufacturers still reference this test. ASTM F 1869 is widely used but often done incorrectly.

There are three key points to doing this correctly:

- The building has to be the same temperature and humidity it will be when the space is occupied (heat or air conditioning must be on);
- The surface of the concrete has to be cleaned by a gentle grinding before the tests go down;
- You need to wait 24 hours after grinding before putting the kits down.

If all three factors are not taken into account, then the results may not be accurate. If that’s not enough, scientists are finding a number of problems with the Calcium Chloride test.

In the September 2007 issue of *Concrete Construction Magazine*, Howard Kanare wrote, “...nearly a half million MVER tests are performed each year in the United States. In the past decade, we have learned that the test can be 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.”

Kanare is with the CTLGroup, one of the pre-eminent concrete testing labs in the country, and I have been honored to work with him as a fellow a volunteer on the ASTM F.06 committee on resilient Flooring. He wrote the groundbreaking book “Concrete Floors and Moisture.”

He goes on to say, “over the past 10 years, CTLGroup has investigated the performance of the MVER test method in the field and in the lab, and we have found that it suffers from several serious deficiencies.” He adds that there is no data from 50 years ago to determine why the kits are the size they are, and there is no research showing why the 3- or 5-lb. limits are so often used by flooring manufacturers. He also says “ambient conditions interfere with test results — warmer, more humid room air can yield higher MVER results even if the internal



New technology in moisture testing makes it easier than ever to measure moisture below the surface of the concrete and make decisions about whether the concrete is ready to receive floor coverings. (Photo Courtesy of Wagner electronics)

concrete moisture condition is unchanged." He warns the test has only proven to measure moisture from the top 1/2- to 3/4-inch of the slab. That is the scariest part for me because most slabs dry from the top down. Therefore, it could be very wet inside, but the calcium chloride test would not reveal that.

Why does moisture below the surface matter? Because moisture vapor moves up — water in the ground or in the slab turns to vapor through the process of evaporation and moves up into the sky to form clouds and then rains down so the cycle can start over again. So, if the slab is damp below the surface, moisture will eventually work its way up — affecting the floor covering and the adhesive.



By drilling a hole, the RH Test method (ASTM F 2170) measures moisture inside the slab, giving a clearer picture of the condition of the concrete than surface test methods such as the Calcium Chloride kit or moisture meters.

So, the moisture meters and Calcium Chloride Tests may not be accurate. What do I do now? The Relative humidity or "RH" Method (ASTM F 2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes) was approved in 2002 and although this is "new" in North America, Kanare explains "RH has been the preferred method for assessing concrete floor moisture conditions in a number of countries for many years."

This test involves drilling holes to measure moisture inside the slab - 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." Kanare agreed, saying "RH testing gives a much more useful picture of the actual moisture condition within the concrete regardless of mix, aggregate types, floor thickness, or surface conditions." I've noticed that limits for RH tests are starting to show up in manufacturer's installation manuals, and Padgett agreed, saying, "Many areas within the industry are moving towards RH testing."



One of the many advantages of the RH method is that it is very easy to re-test at a later date, as compared to the Calcium Chloride test, which takes 60-72 hours.

Because most RH equipment is reusable, you can test the same spot repeatedly and other than the plastic sleeves, the entire RH kit can be re-used. The Calcium Chloride kit is used only once, so over the long-term, RH testing costs less and is more accurate. There also are some single-use RH instruments on the market, which can be left in place until the results are acceptable, but cannot be re-used after that. I can see how this might be a more costly method, but these units cost less than buying the other types of RH equipment and give faster results than the Calcium Chloride test, these are still a good option. Either way, given the accuracy of the RH method, I would

recommend making the investment. I think that the costs of doing the testing should be passed along to the owner as a necessary part of the job.

How can you get trained on concrete moisture testing? The Institute of Inspection, Cleaning and Restoration Certification (IICRC) has developed "Introduction to Substrate/Subfloor Inspections (ISSI)," a three-day course including a 160-question exam. I would highly recommend this course to anyone who is serious about upgrading their level of professionalism regarding moisture testing, including flooring contractors, installers, inspectors and water damage restoration specialists. As more floors continue to fail because of moisture, and more data points to the best ways to test for moisture, it's imperative the industry learn these methods and put them to use on every job.

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