Timothy E Chavey Certified Flooring Professional

Pin & Non-Pin Meters

At best, moisture meters (pin-type or surface-type) may have some practicality as relative (qualitative, not quantitative) measurement devices for possibly indicating best placement for accurate, quantitative relative humidity sensors within the concrete.

Moisture meters, similar to other non-quantitative test methods, are not final determination tools.

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Finally A definitive test

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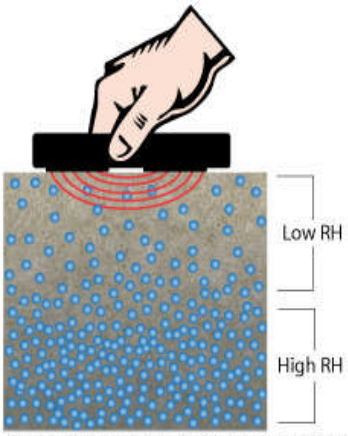
Calcium Chloride test

The calcium chloride vapor emission test was developed over 40+ years ago by Kentile to quantify the volume of water vapor radiating from a concrete slab surface over time. This test has been used to measure the amount of moisture that emits from 1,000 square feet of slab surface in 24 hours. The result is expressed as "pounds" which is the equivalent weight of water, emitted as vapor, over 1,000 square feet in 24 hours. This test requires the use of a gram-weight scale with a gradation of 1/10th (0.1) gram. The calcium chloride container is weighed before and after exposure to the concrete slab. It is highly recommended that the test be weighed prior to, and directly after exposure on the same scale. This is a very sensitive test when conducted properly in an ideal environment. Differences between two scales and extended time between weighing can offset the test result. **DO NOT** conduct this test unless the building environment is representative of the actual working climate. While the test can measure moisture in a wide range of building climates, *the results are only meaningful when conducted in a similar building environment as the finished floor system*. Obtaining meaningful results is only possible when tests are conducted in a representative interior climate.

Calcium Chloride test

In-Situ PH Probe test

The relative humidity probe method, also known as the RH test or the "in situ" test, has been in use in Europe for more than 20 years but is relatively new to the United States. ASTM F2170-02, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes, which was published as an ASTM Standard in 2002, involves drilling approximately 2-inch-deep holes in the concrete to measure the humidity inside. Scientific testing has shown that the calcium chloride test only measures vapor emissions from the top 1 inch or so of the concrete slab. Because most concrete slabs dry from the top down, the calcium chloride test may miss moisture deep inside the concrete that is likely to rise to the surface after a floor covering is installed. For this reason, many now consider the RH test a better predictor of future moisture problems.



Moisture Meters can only measure the top "drier" portion of a concrete slab.

What about my moisture meter?

Moisture meters should never be used to make the final determination as to whether or not a concrete slab is dry enough for a flooring installation. Here's why:

No 'moisture meter' of any type can give consistently accurate 'moisture' readings across the different mixes and densities of concrete. Additionally, other components (metal reinforcing bar, aggregate size and amount, etc.) can cause false indications of 'moisture' especially with non-pin meters. But pin-type 'moisture' meters are also not practical for moisture measurement because variable chemical and physical characteristics in concrete can cause false readings due to changes in electrical resistance that have nothing to do with moisture. Additionally, even IF the so-called 'concrete moisture meters' were sufficiently accurate (again, they are not), they only measure 'moisture' (not relative humidity) in a very small area near the surface of the concrete slab.

This type of surface 'moisture' testing tells us nothing about the conditions down in the slab.

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What? about my moisture meter

Once a floor covering is placed on a concrete slab, the relative humidity (RH) within the slab will equilibrate throughout the thickness of the slab.

This means that a slab that may have been "dry" (low RH) at the surface (without a floor covering) will see a higher RH (migrated from down in the concrete) at the surface, when the floor covering has been installed. This is where the problems occur.

The calcium chloride test method (moisture vapor emission), and the UK-based 'hood' method (RH) both have the same problem, as they are also surface tests. Keep in mind that an uncovered concrete slab will indeed have a relative humidity gradient (typically drier at the surface; much wetter at depth) throughout its thickness until a floor covering is put on top.

"This is where the problems occur."

Moisture meters are qualitative not quantitative

This week a rabbit, next week a floor failure

Under normal conditions, the RH at roughly 50% slab depth will be significantly higher than the surface unless the slab has been down for a long time, **and a vapor retarder is directly underneath the slab.** In reality, the surface of the concrete will more closely reflect the RH in the room or building which gives no indication of the potential for a flooring failure due to the high RH deep in the slab that will migrate to the surface when the concrete can no longer emit water vapor due to the non-permeable floor covering. **Again, most major floor covering and adhesive manufacturers in North America and Europe already have concrete relative humidity specifications in their installation guidelines. At best, moisture meters (pin-type or surface-type) may have some practicality as relative (qualitative, not quantitative) measurement devices for possibly indicating best placement for accurate, quantitative relative humidity sensors within the concrete.**

ASTM Procedure F2170

By drilling a hole in the concrete, the F2170 method can measure moisture deep inside the slab.

Another advantage of the F2170 RH test is that it is easier to repeat. The first test using either method takes about the same amount of time. An F1869 Calcium Chloride test takes four days (grind the slab, wait a day, place the kit, and wait three days), after which a Moisture Vapor Emission Rate (MVER) is calculated. The MVER is stated in pounds per 1,000 square feet per 24 hours -- or "pounds," with 3 or 5 being the limit.

The first F2170 test takes three days (drill the hole, place and cap the sleeve that lines the hole, wait three days), after which the Relative Humidity (RH) is read using a meter. The RH is stated as a percentage RH, with 75 to 80 percent the acceptable limit.

However, each subsequent test is much easier with the F2170 method. A second F1869 test requires another three day wait, while the F2170 test can be repeated without any waiting time because the hole can be reused over and over again. If the initial reading is too high for a floor covering installation, you can come back later, unseal the hole, and quickly read the RH again. There is no three-day waiting period once the hole is drilled and the sleeve is placed and capped.

RH method is absolutely better than the calcium chloride test

Howard Kanare of Skokie, Ill.-based Construction Technology Laboratories (one of the premier concrete testing laboratories in the world) believes the RH method is better than the calcium chloride test. "Calcium chloride tests only tell us about the moisture situation in the upper region of the concrete," he explains. "RH probes can be placed at a specific depth in the concrete to indicate the actual moisture condition deeper in the concrete -- even below the floor slab where moisture originates -- and can monitor trends and indicate the rate of drying, allowing us to predict when a floor will be dry enough for installation" Thus, a slab that is considered "dry" according to the calcium chloride test can wind up "wet" after the flooring is installed, because the dampness in the lower part of the slab has migrated up to the surface. Because there is somewhat of a comfort level in the industry with the calcium chloride test, I inquired as to whether a correlation exists between the two methods. "No, they measure different properties of the concrete," Kanare answered. "F1869 determines a portion of free moisture near the surface that can be pulled out of the concrete over a short time period. F2170 measures the existing relative humidity within the slab at a specific depth."

Thus, a slab that is considered "dry" according to the calcium chloride test can wind up "wet" after the flooring is installed,

F2170 In detail

The F2170 test is the most up-to-date method for testing concrete floor slabs. A plastic sheet taped to the floor is no longer an acceptable method, and even a moisture meter test is not recognized by flooring manufacturers. Few could argue against the comprehensive data the F2170 test yields.

"We have used F2170 RH probes to monitor drying of wet floors and to predict many weeks ahead when a floor would be acceptable for installation. "RH probes can be wired into a 'smart building' that monitors itself and alerts the facility manager if a moisture problem is developing."

We've come a long way from taping a piece of plastic to the floor to see if there is moisture. Hopefully, as more independent testing agencies and flooring dealers and contractors perform more testing, moisture-related failures will be less common. That would be good news for everyone in our industry -- and our customers as well.

A relative humidity meter connected to the probe yields an internal moisture reading. Relative humidity testing represents advanced concrete moisture testing for the 21st century.

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Serving Northern California

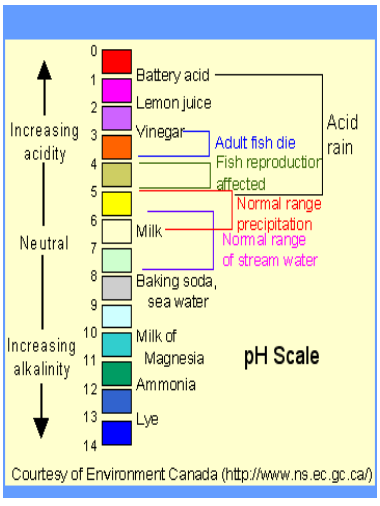
Following ASTM F2170 procedures

Flooring Specialists has the ability/tools to evaluate newly poured or existing concrete substrates possibly eliminating your future liabilities regarding the installation of a moisture sensitive floor covering on a new or existing concrete substrate. Flooring failures due to excessive moisture account for one of the most costly liabilities in our industry.

With a pre-installation cost that up front is less or equal to, 2 to 3% of the price of a future catastrophe, F2170 testing just makes sense. Calcium chloride tests and moisture meters are false positives that have proven their ineptness in protecting the flooring provider from future liability.

Oh one more thing,,, pH

Along with moisture testing, the slab should also be tested for pH. Often, when experiencing a moisture problem, the concrete will also exhibit a high pH reading. As the moisture works its way to the concrete surface, it can bring with it free salts from within the concrete. It is often the combination of moisture and alkalinity that causes problems for the floor covering adhesive. Most floor covering and adhesive manufacturers recommend that the pH not exceed 9. Figure #1 shows that on the pH scale 7 is neutral. Newly placed concrete will exhibit a pH of 13 or so. As the concrete is exposed to the air, carbonation occurs, reducing the pH at the surface. pH may be tested with pH paper, pH pencils and pH meters.



Identifying the pH of the surface is important before moving on with floor covering installation or the use of a mitigation system.

Before moving forward, consider the moisture & pH test results along with everything else you know about the concrete and the building. Remember, the CCT moisture test is simply identifying the amount of moisture present (MVER through CaCl testing) at that given point in time, whereas the F2170 test gives you an exact tool to determine the slabs current/future suitability.

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