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FEATURES

How to Moisture Test Concrete Floors

No single test tells you everything.

By Tom Klemens

The standard requires three tests for the first 1000 square feet of floor, with additional tests for additional floor area. Similar to the plastic sheet test, this procedure tests for moisture being emitted under a sealed area of concrete. However rather than measuring humidity under the enclosure, the test captures the moisture in a sample of calcium hydroxide that starts out very dry. As each calcium chloride test is being set up, a sealed packet of calcium hydroxide is emptied into a small container and weighed. The container is then placed on the concrete under an enclosure and left open to the air under the enclosure for 72 hours. At that point, it is again weighed; the increase in weight indicates the weight of the moisture emitted by the slab over that time.

After some calculations using the weight change and the area under the test device, the test results are expressed as the number of pounds of water being emitted per 1000 square feet of floor in a 24-hour period. Several companies offer kits that include all the materials needed to set up and run this test according to the standard.

Most flooring manufacturers recommend that their products not be installed if the moisture transmission rate exceeds 3 pounds, although some allow installation for certain materials at rates of up to 5 pounds. ASTM standard tests usually avoid specific interpretation of test results. However, a more formal guideline on the moisture vapor emission rate is found in ASTM F 710 “Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring,” which says concrete can be considered suitably dry when the vapor emission does not exceed 3 pounds.

For test results to be useful, it is very important that testing be conducted under stabilized environmental conditions. They should represent the long-term conditions under which the building will be expected to perform. For example, the indoor relative humidity is generally reduced after a building's heating, ventilating, and air-conditioning systems have been turned on, and that makes the moisture in a slab behave very differently. Whether heating or cooling, HVAC systems dry the air inside enclosed spaces. That upsets the equilibrium previously reached, and the moisture vapor emission rate can be expected to increase. Hence, the need to test after these systems have been turned on.

Credit: Engius

For in situ humidity testing, this sensor is inserted into a hole drilled into the slab, where it reads the relative humidity at the midpoint of the slab. Note the o-ring seals.

The software touch

Another way to test the moisture in concrete slabs is with a humidity meter. One type uses sensors to measure the dielectric constant of the concrete, then processes that information to report the moisture content. Many of these surface-testing devices can also be calibrated to measure the moisture content in other solid materials, such as masonry, brick, or wood. Their primary drawback is that they measure the moisture in only about the first inch of material. Also, there is no ASTM standard test for their use in measuring moisture in concrete slabs.

The same technology has been applied in a second type of moisture meter that measures the relative humidity directly. These devices generally consist of a probe that is inserted into a hole drilled in the

slab. The probe houses a sensor that measures the relative humidity in the air within the test hole. With the probe sealed in place, the setup is allowed to come to equilibrium for 72 hours, at which time readings can be taken.

A test method for using this type of equipment was issued in 2002 as ASTM F 2170, “Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using *in situ* Probes.” It contains provisions for obtaining measurements in hardened concrete using the drilled-in approach, as well as allowing placement of plastic tubes with plugs in fresh concrete to facilitate testing once the concrete has hardened.

Credit: Vaisala

A kit for in situ testing includes the probes, the moisture meter, and other components of the concrete humidity measurement system.

Numerous interesting variations can be found in the equipment available for this type of moisture measurement. Vaisala's probes use a sensor with a thin polymer film that absorbs or releases water vapor as the relative humidity of the air in the test bore rises or falls. That changes the dielectric properties of the polymer, which have been precisely correlated with humidity, so the system permits very accurate humidity readings.

Wagner Electronics offers a self-contained relative humidity probe that is inserted into the concrete and left in place. Besides the battery and moisture sensor, it includes a digital readout only about the size of a dime on the top of the device.

Engius is offering two versions of its relative humidity logger—one for drilled-in use prior to installing floor coverings, in accord with ASTM F 2170, and the other for embedding in fresh concrete. The cast-in-place version is designed to record the internal humidity of the concrete and monitor curing conditions for as long as a year.

A hand-held combination unit from Tramex can operate in moisture measurement mode to measure the moisture content in concrete. Switching to hygrometer mode, it measures the temperature, relative humidity, and dew point of the environment adjacent to the slab. Hooking the device to probes allows it to measure those same parameters within the floor slab.

The answer is both

While the *in situ* measurement of relative humidity does give an overview of the moisture throughout the slab, it does not directly address the issue of moisture vapor pressure. Similarly, the calcium chloride test shows what a slab's surface water vapor activity is like but does not take into account moisture content deeper within the slab. And in both cases, any test is only a snapshot of conditions at a particular spot at a particular time.

Because the moisture within slabs is so prone to movement when temperature and humidity change, it would seem that testing for both moisture content and moisture emission vapor pressure would be wise. And it would also seem imperative to test when you've gotten realistically close to the building's final operating conditions. The wisdom in this approach and its accompanying reduction in guesswork should result in better results for all concerned.

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I found this article very informative, needed more specific information about existing house slab with moisture issues and how to further investigate if integrity of slab could be compromised by high moisture levels in slab for a period of 8 years.

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